PRACTICAL WORK IN GEOGRAPHY

Part II

A Textbook for Class XII
(Semesters III and IV)

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FOREWORD

The present textbook *Practical Work in Geography–Part II* is meant for Semesters III and IV of Class XII It is based on the revised Geography Curriculum for the Higher Secondary Stage, prepared as a follow-up of *National Curriculum Framework for School Education*–2000 (NCFSE–2000).

The Geography Course at the Higher Secondary Stage has been divided into four semesters. Each semester has components of theory and practical work linked with each other. While *Practical Work in Geography–Part I* covers Semesters I and II of Class XI, the present book covers Semesters III and IV of Class XII.

The present book seeks to familiarise learners with the modern tools and techniques of geographical enquiry. Collection of information and data, their analysis and presentation in verbal and visual forms, use of computers in data processing and Geographical Information System (GIS) in area planning are essential tools of geographical enquiry in present-day learning. Introduction of modern techniques like use of computer in map making and GIS will equip the learners with skills to face challenges of the modern days and make them aware of the potentialities of these tools.

The Council acknowledges the contribution of the author, the editor, subject experts, practising teachers and the internal faculty members associated with the preparation and finalisation of this textbook. Suggestions and comments from the users for qualitative improvement of the book are welcome.

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GANDHIJI'S TALISMAN

"I will give you a talisman.Whenever you are in doubt or when the self becomes too much with you, apply the following test :

Recall the face of the poorest and the weakest man whom you may have seen and ask yourself if the step you contemplate is going to be of any use to him. Will he gain anything by it ? Will it restore him to a control over his own life and destiny ? In other words,will it lead to Swaraj for the hungry and spiritually starving millions ?

Then you will find your doubts and your self melting away."

MKGandhi

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CONSTITUTION OF INDIA

Part IV A

Fundamental Duties of Citizens

ARTICLE 51A

Fundamental Duties - It shall be the duty of every citizen of India —

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) To promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture,

(g) to protect and improve the natural environment including forests, lakes, rivers, wild life and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence,

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement.

Unit III

PROCESSING OF DATA AND THEMATIC MAPPING

1

CHAPTER

DATA ANALYSIS, DIAGRAMS AND MAPS

INTRODUCTION

We have already been introduced to Practical Geography in Class XI. It is a branch of Geography that deals with the basic laboratory techniques and field methods of geographical enquiry. It supplements the theoretical parts of the discipline.

We have covered fundamentals of maps, latitude, longitude and time, map projections, topographic maps, remote sensing, weather instruments and charts as part of Units I and II of the Course. Now we propose to move further and study the nature of geographic information; how to collect and analyse it; and how to convert it into diagrams and maps. We propose to lay special emphasis on the use of information technology and computers in data processing and management.

GEOGRAPHIC DATA

Geographic data constitute a set of information giving the spatial spread or distribution including density of a phenomenon through time and in relation to other phenomena. Since Geography deals with both natural and human phenomena, geographic data range from rocks of the earth surface to climate, crops, industries, animals and humans and all the attributes of each of them. Geographic data can be both qualitative or quantitative.

In this Chapter we will discuss only quantitative data.

SOURCES OF DATA

There are two main sources of geographic data: primary and secondary. Data collected directly from the field by counting a phenomena or interviewing people is called ***primary data***. ***Secondary data*** is not collected by the user directly, it is already published or available with some one. The user lifts the data and derives his conclusions taking them as authentic.

The main source of primary data is field investigation. We will discuss more about it in Chapter 5. The sources of secondary information are too many to list here. Each specialized agency gathers and publishes its own relevant data. Census of India publishes population data; Agriculture Department publishes agricultural data, Water Resource Department publishes water-related data. There is another major source of data which is used by geographers more than other professionals. Maps are that source. In India maps are published by Survey of India (SOI) and National Atlas and Thematic Mapping Organization (NATMO). Survey of India publishes topographical maps on various scales while NATMO publishes thematic maps.

Diagrammatic representation of data is another important characteristic of Geography. One can convert a huge table of data into graphs, charts or maps and present its salient features visually. Such maps give visual view of the distribution of selected phenomena or a set of phenomena in relation to each other.

DATA ANALYSIS

- ***Collection of Data*** is first step in its utilisation. Care is taken to record data as accurately as possible. Because defective data lead to defective results.
- ***Data Classification*** involves editing, classification and organisation of the collected data to present the same in condensed forms. The sum total of computing, tabulating and statistically

transforming relevant information in a suitable format is known as data analysis. The first step in this process is classification of the data according to some common characteristics

Data classification involves the following main steps :

1 Classifying data on the basis of time, region, quality, magnitude, etc
2. Tabulating the data in the form of tables, without loosing their accuracy.
3. Processing the data using suitable statistical techniques

ORGANISATION AND PRESENTATION OF DATA

Arrangement of data in a given logical format and presenting them in tabular forms is called the organisation of data Statistical methods can then be employed to summarise the data, diagrams, graphs and thematic maps are the other ways of summarisation Thus, data analysis involves statistical techniques as well as cartographic techniques.

STATISTICAL MEASURES USED FOR ANALYSIS OF DATA

Following are a few simple and commonly used statistical measures for analysis of data

(a). *Measures of Central Tendency :* We can use these measures to get a summary of a big array of data. These measures are ·

1. Arithmetic Mean
2 Geometric Mean
3 Harmonic Mean
4. Median
5 Mode

Arithmetic mean, popularly known as average, is the most commonly used central tendency.

(b). *Measure of Dispersion :* It is a measure that shows the extent of deviation of the items of a series which can be derived using the arithmetic mean. We propose to discuss only

1. Range
2. Mean deviation
3. Standard deviation
4. Quartile deviation

(c). *Correlation* · It shows association and relationship between two or more variables.

(d). *Index Number :* It converts discrete and unrelated absolute data in percentages to make them comparable

(e) *Regression* . It helps in finding out the best estimated value of a missing variable, given the corresponding value of the independent variable Independent variable is the one that is presumed to be constant. Dependent variable is one that changes with change in the independent variables

DIAGRAMS

Diagram is the representation of data in a form that is visual-cum-statistical and at the same time simple and generalized Some of the commonly used diagrams are . bar diagram, pie-charts, graphs, pictograph, cartograms, etc.

Diagrams are classified into three main categories depending upon the dimensions they take into account. In one dimensional diagrams height conveys the quantity. The two dimensional diagrams show areal (length, width) spread and distribution. In three-dimensional diagrams volume (width, length, height) conveys the quantity expressed (Fig.1.2) To sum up, diagrams can be broadly grouped into three categories ·

1. One dimensional : bars, line diagrams, etc;
2. Two dimensional : circular, rectangular and squares diagrams; and
3 Three dimensional : block piles, spherical and cubical diagrams

There are other types of diagrams also which can be selected according to the requirement as shown in Fig 1 2.

CONSTRUCTION OF DIAGRAMS

Diagrams make it easy to compare data of different places, times and variables. When maps and diagrams are combined we get thematic maps. While constructing a diagram the following points are to be kept in mind .

1. *Type* : The selection of a particular diagram

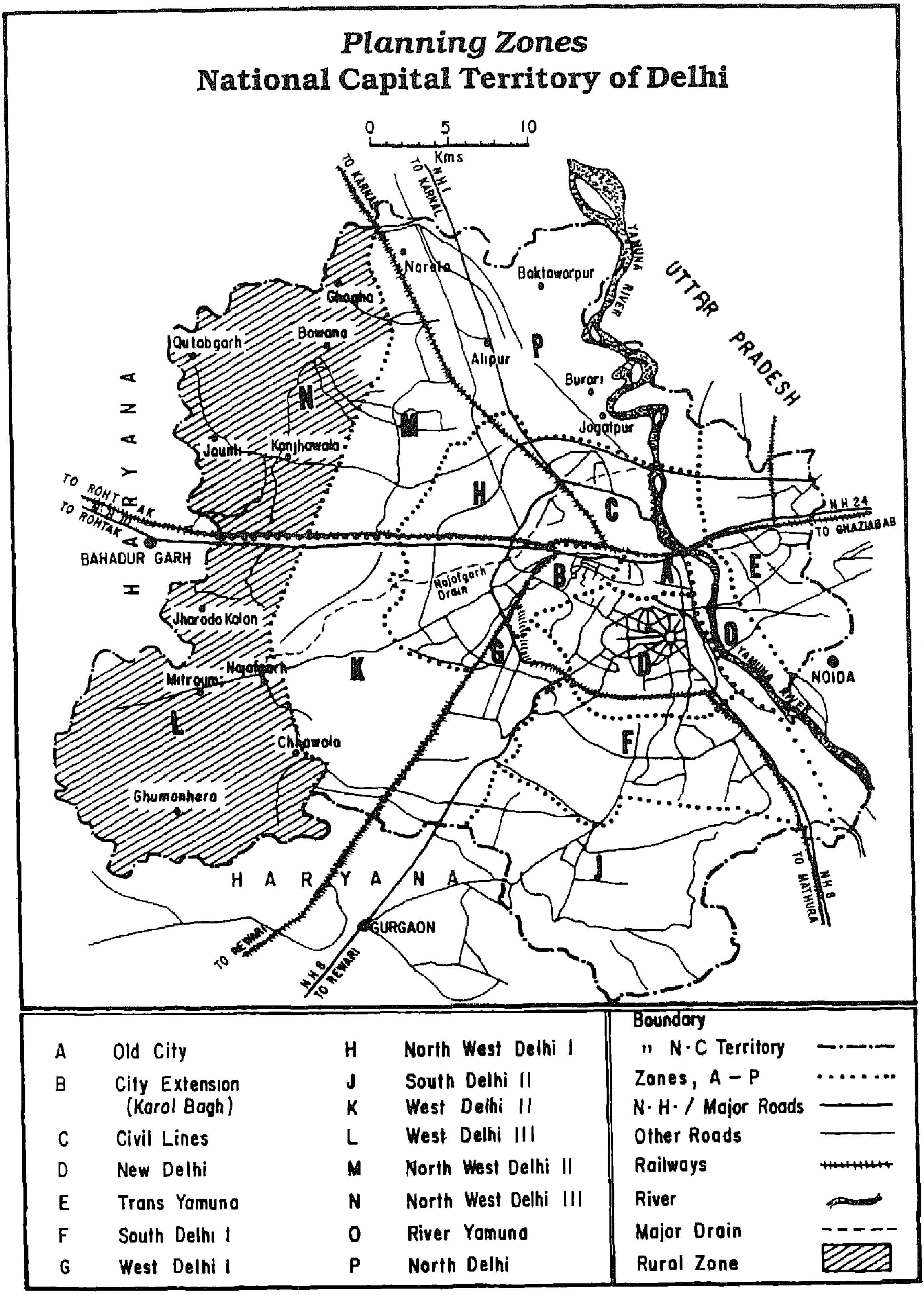


Fig. 1.1 : *Planning Zones , National Capital Territory of Delhi*

will depend on the nature of the data and the purpose of drawing the diagram

2. *Scale* · The scale should help depict a given data without compromising its visual quality. The scale size will also depend upon the size of the paper and the range of data values.
3. *Labelling* The place name, variable and time (year) respectively should be in medium, large and small fonts
4. *Symbolization* . It can be done by the use of proper signs, colours and lines (dotted, broken and bold)
5. *Axis* : In a diagram with two axes the length of X-axis (horizontal) may be put ideally one and a half lines of Y - axis (vertical)
6. *Aesthetics* : For making it attractive and effective, there should be less use of words and numbers Thickness of lines or curves should be uniform. Borders can be shown with appropriate thickness of lines.

Merits of the Diagrams

A well drawn diagram will have the following qualities

1. It would be simple and understandable. Even statistical information would be so simplified that it would give a simple but effective look to the diagram
2. It would leave long lasting impression in the readers' mind
3. It would be effective in conveying the information or message
4. It would facilitate comparison; and
5. It would be helpful in prediction of the behaviour of variables

Limitations of Diagrams

1. Diagrammatic presentations of data are an approximation of the actual behaviour of the variables. Diagrams show only an aggregated behaviour of the variables.
2. All data are not amenable to diagrammatic presentations and
3. A diagram gives only a preliminary idea, to arrive at the final conclusion, one has to look into the details of the data.

MAPS

Map may be defined as the representation of the earth's surface as a whole or a part of it on a plane, with the help of conventional signs It is drawn to scale and on a suitable projection so that each and every point on it corresponds

A Detailed Typology of Diagrams

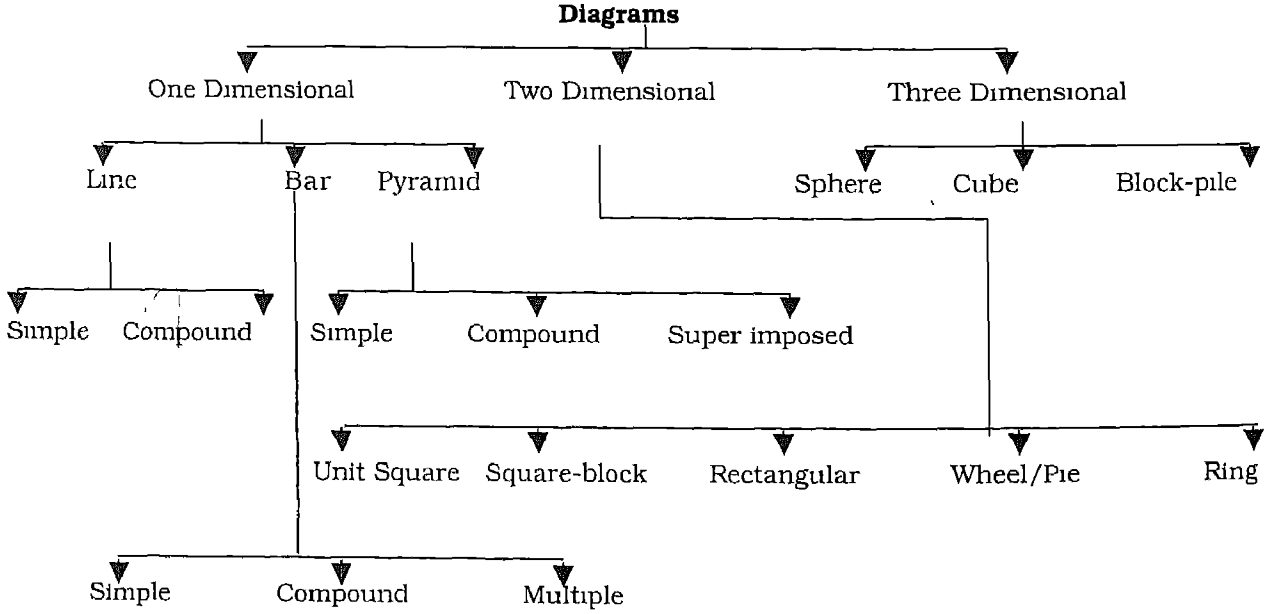


Fig. 1.2 : A Detailed Typology of Diagrams

to the actual terrestrial or celestial position A map without a scale and projection is called a sketch map

Data are generally collected for different administrative units such as villages, blocks, districts, cities, states or countries. Some data pertain to natural units like river basins, mountains and valleys These data when depicted on maps show density pattern, dispersion and distribution of the phenomenon under consideration A study of such maps facilitates areal differentiation and convergence (Fig 1.1)

Maps employing statistically analysed data are known as statistical maps They include choropleth, isopleths and dot maps. Such maps are first prepared in two parts· (a) outline map, and (b) base map. The outline map shows the areal units to which the data pertain For example, for showing ***state-wise population density in India*** the outline map of India should show state boundaries Different base maps are required for showing the distribution. For example, if population distribution is to be shown, physiographic map is required to establish correlation between the two. For showing rail and road networks, base maps depicting relief and drainage will be required. Similarly, for crop maps, base map showing climate and soil will be indispensable.

Types of Maps

Maps can be classified in different ways

I. On the basis of scale maps can be classified into .

(i) Cadastral maps — scale being 1·4000 or 1:2500.

(ii) Toposheets or Topographic maps – scale being 1:50,000, 1:25,000, 1·10,000,00 and 1.10,000,000

(iii) Atlas or wall maps – very small scale maps

II. On the basis of themes or their functions, maps can be classified into

(i) Relief maps — depicting surface features or landforms.

(ii) Climatic maps — depicting climatic phenomena

(iii) Population maps—depicting demographic information.

(iv) Political or Administrative maps — depicting political or administrative units. These maps are used to show different statistical analysis of data or information, which are generally compiled on the basis of these administrative units

IMPORTANCE AND USES OF MAPS

All disciplines use maps in one way or the other because they present a picture which is nearest to the real ground situation Maps are more effective as they make a direct appeal to the mind and even the unknown and unseen features may be unfolded in their original form Good maps furnish us with a wealth of information in its true perspective and they are as good as pages of description

Maps are the indispensable tools for geographers, No other science is so much dependent upon maps as Geography Therefore, while the map is a guide and help to individuals in general, the governments and the corporate bodies in particular, it is a "shorthand script" of geographers It renders a systematic study of our earth and its surrounding that is easily comprehendible

EXERCISES

Review Questions

1. Answers the questions briefly .
   (a) What are geographic data?
   (b) What are the steps for data classification?
   (c) What are the primary sources of data?
   (d) What are maps?

2. Write short notes on the following :
    (a) Thematic maps
    (b) Classification of diagrams
    (c) Uses of maps
    (d) Measure of Dispersion
3. Compare the primary and secondary sources of data
4. Define measures of central tendency.
5 Explain various points to be considered while constructing diagrams.
6 Differentiate between outline maps and base maps.

2

CHAPTER

PROCESSING OF DATA

Raw data collected from the field or from secondary sources are processed before they are used to prepare a map, report, scientific paper or even a book like the present one. Processing involves arranging the data in a tabular form and analysing them statistically As discussed in the previous chapter, tabulation and analysis are the two major elements of data processing. By tabulation, we mean the systematic presentation of the information contained in the data. Data is arranged in rows and columns in accordance with some salient features.

TABULATION

Tabulation is one of the most important and ingenious devices to present data in a condensed and readily comprehendible form It attempts to furnish maximum information in minimum possible space, without sacrificing the quality and usefulness of the data Tabulation overcomes the drawback of the repetition of explanatory phrases and headings and presents data in a neat and required perspective.

A good table should be simple, compact, complete and self-explanatory, and should be

Format of a Blank Table

Table No .. . . TITLE .. . .

(Head Note or Prefatory Note (if any))

Sub Heading	Caption				
	Sub-Heads		Sub-Heads		
	Column Head	Column Head	Column Head	Column Head	Column Head
Total					

formatted keeping in view the nature, scope and objectives of the enquiry

Generally, a table contains .

- Table Number and a brief Title
- Sub Title (if necessary)
- Captions and Stubs (heading or designation for vertical columns and horizontal rows respectively)
- Body of the table containing classified data into rows and columns as necessary
- Totals of rows in the last column and those of columns in the last row
- Sources of data

We can see the format of blank table containing above parts in the previous page.

A total number of 1807 students applied for admission to M.Sc. Geography course in Delhi University. Of the total applicants, 812 were from Delhi and the rest from other states of India. Among the students from Delhi 500 were girls and 312 boys while the corresponding figure for students from others states was 95 and 900 respectively.

Of the total number of applicants 1200 students needed hostel facilities of which 300 were from Delhi and the rest from other states. Of the 300 students from Delhi requiring hostel facilities 200 were girls and 100 were boys. While the corresponding figure for students from other states was 95 and 805 respectively. The above data can be tabulated as shown below

ANALYSIS

Once a table is ready, the stage is set for statistical analysis of the data. We will discuss only a few of the simple tools of statistical analysis

Mean or average is a quotient of the sum of several quantities. It is a number that by and large represents a series of numbers What do we mean when we say Manoj is an average student? It means that Manoj is neither too good a student nor too bad. He does not get very high marks nor very low. He stands somewhere in the middle. So, average can be taken as the central value or tendency of the population, in this case, all the students of your Class.

There are ***three*** different measures of central tendency, each is calculated and used differently .

1. Mean
2. Median
3. Mode

Mean or average can be of three types .

1. Arrithmetic
2. Geometric, and
3. Harmonic mean

Here, we shall discuss arithmetic and geometric mean

Arithmetic Mean (A.M.)

A.M. is calculated by adding a given set of values and dividing the sum by the total number

Table 2.1 **: Status of the Students Applied for Admission in M.Sc. Geography Course**

	Students from Delhi			*Students from other States*			*Total*	
	Girls	Boys	T	Girls	Boys	T	Girls	Boys
Number of Applicant	500	312	812	95	900	995	595	1212
With Hostel facilities	200	100	300	95	805	900	295	905
Without Hostel facilities	300	212	512	0	95	95	300	307

of individuals This can be expressed mathematically as

$$\overline{X} = \frac{\sum x}{N}$$

* where $\overline{X}$ is the mean

Σx is the total of given values

N is the number of items

For Example We take marks obtained by each student in a class of five students named A, B, C, D, and E.

Students	*Marks*
A	65
B	75
C	80
D	75
E	55

Therefore,

$$\text{A M.} = \frac{\text{Sum of marks obtained by all students}}{\text{Number of students}}$$

$$= \frac{65+75+80+75+55}{5}$$

$$= \frac{350}{5}$$

$$= 70$$

When the number of observations are large, we may average the data in a desired number of groups in a frequency table

The A.M. may be formulated as :

$$\overline{X} = \frac{\sum f \times m}{\sum f}$$

where $\overline{X}$ is the A M

f is the frequency, i.e. number of times the item is repeated.

m is the mid value of any class.

Let us look at this case with an example : Percentage of marks obtained by 50 students is given here

Percentage of Marks

59	47	87	46 (L)	91
68	80	65	50	69
95	77	96 (H)	94	82
84	91	49	92	74
88	83	79	88	79
76	94	83	82	57
81	78	87	71	85
75	62	83	69	80
79	58	67	55	76
93	63	70	63	56

We calculate the A.M in the following steps ·

Step–1 the lowest (L) and highest (H) values are L = 46, H = 96

Step–2. Calculate the range (R) by deducting L from H
i e. R = H - L
R = 96-46 = 50

Step–3 Divide the range by the desired number of classes (N) to determine the class intervals (C.I), i e.

$$\text{C I} = \frac{R}{N}$$

$$\cdot\ \text{C.I.} = \frac{50}{5} = 10$$

taking N = 5*

- The number of classes should neither be too small nor too large.

Step–4. Determine the class limits (lower and upper boundaries) by adding C I. as many times with L as number of classes till the H value is obtained

Thus, the lowest limit = 46 (Lowest value)

next limit = 46 + (1 × 10) = 56

next limit = 46 + (2 × 10) = 66

next limit = 46 + (3 × 10) = 76

next limit = 46 + (4 × 10) = 86

and the highest limit = 46 + (5 × 10)
= 96 (Highest value)

So, Ist class will be from 46 to 56
IInd class will be from 56 to 66
IIIrd class will be from 66 to 76
IVth class will be from 76 to 86
Vth class will be from 86 to 96.

Step-5. Arrange the data in the frequency table with 5 classes by tally methods ·

Table 2.3 **: Frequency Distribution of Marks**

Classes	*Class interval*	*Mid Value (m)*	*Tally Marks*	*Frequency (f)*	*f. x m*
I	46-56	51	卌 I	6	306
II	56-66	61	卌 II	7	427
III	66-76	71	卌 卌	10	710
IV	76-86	81	卌 卌 卌	15	1215
V	86-96	91	卌 卌 II	12	1092
Total	-	-		50	3750

Source : Calculated from the data in Table 2 2

Step-6. Now the frequencies are multiplied by the respective mid values and the products which are added to get $\Sigma f \times m$

Step-7. The A M. is calculated using

$$\bar{X} = \frac{\sum f \times m}{\sum f}$$

$$\text{A M.} = \frac{3750}{50} = 75$$

Note : The concept of frequency is used in computation of other forms of averages.

Uses of A.M.

- Arithmetic mean involves all individuals in accounting. So, it gives a fair wholesome idea about population as a whole.
- It is the average of the values in the set so that it balances the values of the entire distribution, i.e sum of deviation of individual values from mean is equal to zero, i.e.

$$\sum\left(x - \bar{X}\right) = 0$$

Because of this property, A.M is used as a *parameter* in various computations. While using A.M, we should be aware of its weakness too If the items to be averaged are few and differences among them too wide, A M. can give a distorted picture Let us take an extreme case of two persons, A and B having annual income of Rs. 50,000 and Rs 1000 respectively. The A M. of the two values will be 50,000 + 1000 = $\frac{51000}{2}$ = 25500. If we do not know the two values, we will consider both to be in the middle-income group This however, is not so. B is in fact very poor

GEOMETRIC MEAN (G.M.)

Geometric Mean (G.M.) is used to compute the rate of growth of any item.

The G.M.of n values, for example, $x_1, x_2, x_3 \cdot \cdot x_n$ is defined as the nth root of the product of these values.

So, we may express this mathematically as:

$$\text{G.M} = (x_1 \cdot x_2 \cdot x_3 \quad x_n)^{\frac{1}{n}}$$

The G.M. may be calculated using following example :

Growth rates of the economy in 4 years are given as 4,8,8 and 16 % respectively.

$$\text{So, G M.} = (4 \times 8 \times 8 \times 16)^{\frac{1}{4}}$$

$= 8\%$.

Uses of G.M.

G.M. is more suitable average if data are given in terms of ratios or in terms of change in which use of A.M. may lead to inconsistent results

MEDIAN

Median is the positional average. It is defined as the middle most value of variables when arranged in ascending or desceding order. It is denoted as 'Me'.

Table 2.4 **: Age of Individuals**

Rank of Individuals	*Ascending Order*	*Descending Order*
1	19	23
2	20	22
3	21(Median)	21(Median)
4	22	20
5	23	19

Example : *Calculate the median when age of five individuals A,B,C,D and E are respectively 20,21,19,23 and 22 years.*

We determine the median in the following steps :

Step–1. Arrange the data in ascending or descending order in a tabular format :

Step–2. The value of the middle number is the median.

Step–3. The middle number is calculated by

$$M = \frac{n+1}{2}$$

here n = 5(odd), so $\frac{n+1}{2} = \frac{5+1}{2} = 3$

Therefore, the value of 3rd number will be the median.

Median = 21 years

Where n = 4(even), $\frac{n+1}{2} = \frac{4+1}{2} = 2.5$

So, if we have say 4 members, 19, 20, 21 and 22, in this case we will add the values of 2nd and 3rd number and divide the total by 2 :

i.e. $\frac{20+21}{2}$ = 20.5 years,

In that case Median = 20.5 years.

Uses of Median

1 Median is the middle most value, so the extreme values do not vitiate its representative character as in case of A.M.
2. The median is the centre of gravity for the entire distribution.
3. Use of median is however not very common.

The Median (M_e) for a large number of distributions can be calculated from the frequency distribution.

MODE

Like Median, the Mode is a positional average too. It is a value of the variables, which occurs most frequently.

Example : *Determine the Mode from the following distributions:*

2,10,5,7,7,9,2,7,11,17,7,8

We can determine the Mode in the following steps :

Table 2.5 **: Arrangement of Data**

Sl. No /Type	1	2	3	4	5	6	7	8	9	10	11	12
Ascending	2	2	5	7	7	7	7	8	9	10	11	17
Descending	17	11	10	9	8	7	7	7	7	5	2	2

Step-1 Arrange the data in the ascending or descending order in tabular format

Step-2 In both ascending and descending order value '7' is occurring most frequently, i.e. 4 times

So, the Mode = 7

Uses of Mode

Mode can be used in certain types of distributions in which values are whole numbers. Consider, for example, family size. The mode will be the most common sized family and may for some purposes be regarded as more representative than mean. It certainly represents the typical family Mean family size may be say, 4 8 children whereas the modal family size will be 4 or 5. We know that there can not be 4 8 persons in real life.

Take another example, if most of the students of your class prefer fruits to sandwitch and the caterer is supposed to provide only one of the two choices, your class will be represented by fruits

MEASURES OF DEVIATION

Deviation or Dispersion simply means scattering or variation of the variables about a central value

We can take four alternative measures of deviation :

- Range
- Mean Deviation or Absolute Deviation
- Standard Deviation
- Quartile Deviation

Range (R)

The range is the simplest of the measures of deviation It is defined as the difference between the highest (H) and the lowest (L) values of a given set of measurements.

i.e. R = H-L
as explained earlier.

***Example** : Determine the range for the following percentage of marks obtained by 5 students 83, 96, 72, 46, 68 respectively.*

We determine the range in the following manner ·

Step-1 Determine the highest (H) and lowest (L) values in this case H = 96 and L = 46.

Step-2 We calculate the range using formula
R = H- L
□ (Range) R = 96 - 46
= 50%

USE OF RANGE

A range is rather a crude measure of deviation because it does not indicate anything about the way the values are distributed within the range

MEAN DEVIATION OR ABSOLUTE DEVIATION

Mean Deviation (M D) is the absolute deviation (i e. ignoring sign) from Mean ($\overline{X}$)

We can mathematically put M D as

$$\text{M.D.} = \frac{\sum|x-\overline{X}|}{N}$$

Where X = any value of population

$\overline{X}$ = The mean of population

N = Total number of population

***Example** : Determine the Mean Deviation (M.D.) for the following population 6,8,4,12,5*

We calculate the M D. in the following steps

Step-1. Calculate A M ($\overline{X}$) as mentioned earlier :

$$\overline{X}\ \text{(Arithmetic Mean)} = \frac{6+8+4+12+5}{5}$$

$$= \frac{35}{5}$$

$$= 7$$

Step-2 Deduct the value of $\overline{X}$ from individual member in a tabular format :

Table 2.6 : Calculations for Mean Deviation

x	*6*	*8*	*4*	*12*	.	*Total*
$X-\overline{X}$	-1	+1	-3	+5	-2	0
$\lvert X-\overline{X}\rvert$	1	1	3	5	2	12

Step-3 So the mean deviation is

$$\sum|X - \overline{X}| = \frac{12}{5}$$

= 2.4

Standard Deviation

Another measure of deviation calculated using A M. ($\overline{X}$) is standard Deviation( ). This is also known as Root Mean Square Deviation.

This can be mathematically formulated as :

$$\nearrow = \left[\frac{\sum(X - \overline{X})^2}{N}\right]^{\frac{1}{2}}$$

(Sigma)

The square of the S.D. is known as 'variance'

Example *: Calculate Standard Deviation of the following distribution of 6,8,4,2,5.*

We calculate the S.D. ( ) in the following steps .

Step-1. Determine the A.M ($\overline{X}$)

$$\overline{X} = \frac{6+8+4+2+5}{5}$$

= 5

Step 2. Determine the square deviations from A.M in a tabular format as shown in Table 2 7

$$\sigma = \sqrt{\frac{20}{5}}$$

= 2

So the Standard Deviation of the above distribution is

$\sigma = 2$

Quartile Deviation

Median (Me) divides the total distribution into two equal halves, but quartiles divide the total distribution into 4 equal parts.

The lower quartile (Q_1) is such that $\frac{1}{4}th$ of the total distribution will be less than it and $\frac{3}{4}th$ of the the total distribution will be above this value.

The middle quartile (Q_2) is such that $\frac{1}{2}$ of the total distribution will be below it and $\frac{1}{2}$ above it. Thus, middle quartile (Q_2) is nothing but the median (Me)

The upper quartile Q_3 will divide the entire distribution in such a manner that $\frac{3}{4}th$ will be less than this and $\frac{1}{4}th$ above it.

The quartile deviation (Q.D.) is called as semi interquartile range, which may be expressed as .

$$Q.D = \frac{Q_3 - Q_1}{2}$$

Example *: Determine the Quartile Deviation for the following distribution :*

46, 32, 25, 50, 72, 35, 75, 65, 58

Table 2.7 **: Calculation of Square Deviations**

Sl No./Items	1	2	3	4	5	*Total*
X	6	8	4	2	5	25
$(x - \overline{X})^2$	$(6-5)^2 = 1$	$(8-5)^2 = 9$	$(4-5)^2 = 1$	$(2-5)^2 = 9$	$(5-5)^2 = 0$	20

We can determine the Q.D. in the following steps :

Step-1. Arrange the distribution in ascending order and rank them serially as below

Distribution	*Sl. No.*
25	1
32	2
——— $Q1 \rightarrow \rightarrow$	$\frac{2+3}{2}=2.5$
35	3
46	4
50 ——— $Q2/Me \rightarrow \rightarrow$	5
58	6
65	7
——— Q_3 ——— $\rightarrow$	$\frac{7+8}{2}=7.5$
72	8
75	9

Step-2. The middle quartile (Q_2) or the median (Me) is the middle most member, i.e.

$\frac{n+1}{2}=\frac{9+1}{2}$ = 5*th* value (as n = 9)

Step-3. The lower quartile (Q_1) is the half of lower half, i.e. $\frac{5}{2}$ = 2.5th value

$$Q_1=\frac{32+35}{2}$$

= 33.5

Step-4. The upper quartile (Q_3) is the half of upper half, i.e. $\frac{7+8}{2}$= 7.5th value

$$Q_3=\frac{65+72}{2}$$

= 68.5

Step-5. The quartile deviation (Q.D.) is calculated by

$$Q.D=\frac{Q_3-Q_1}{2}$$

$$=\frac{68.5-33.5}{2}$$

$$=\frac{35}{2}$$

= 17.5

Note : The quartile deviation may not be uniquely determined in some cases of ungrouped data as in the above example

CORRELATION

A distribution of two sets of variables is known as bivariate distribution where these two variables are said to be correlated if the change of one variable results in a corresponding change in the other variable The first variable causing a change of second variable is known as independent variable (X) and the other variable is known as dependent variable (Y). An estimation of the strength and direction of the association between two variables is called simple or bivariate correlation. The most commonly used measure of correlation is known as Pearson's product moment correlation co-efficient (r)

The value of r ranges between + 1 to -1. Thus, when :

r = +1, The correlation is perfect and positive

r = 0, No correlation or Zero correlation

r = -1, The correlation is perfect and negative.

The product moment correlation co-efficient may be mathematically be expressed as

$$r=\frac{N\sum XY-\sum X\sum Y}{\sqrt{[N\sum X^2-(\sum X)^2][N\sum Y^2-(\sum y)^2]}}$$

Where X is the independent variable

Y is the dependent variable

N is the total number of distribution.

Example : *Calculate the Pearson's correlation co-efficient from the following size of plots and selling prices :*

Plot Size (ha)	10	16	19	22	28
Price ('000 Rs)	45	55	75	100	105

We can calculate Pearson's product moment correlation co-efficient in the following tabular format

Step-1 Arrange the data sequentially in a proper table showing separately the two variables Add them separately

Step-2 Multiply X and Y and add them. Thus
$\Sigma X = 95$, $\Sigma Y = 380$, $\Sigma xy = 7895$
and $\Sigma X^2 = 1985$ and $\Sigma Y^2 = 31700$

Step-3. Using formula we calculate Pearsons Product moment correlation co-efficient :

$$r = \frac{(5\times 7895)+(95\times 380)}{\sqrt{[5\times 1985-(95)^2][5\times 31700-(380)^2]}}$$

$$= \frac{39475-36100}{\sqrt{(9925-9025)(158500-144400)}}$$

$$= \frac{3375}{3562.30}$$

$= +0.95$

So, it may be said that price of the land is perfectly and positively correlated with the size of the land.

Table 2.8 : Calculation of Correlation Co-efficient

Sl No	*Size of Plots (ha) (X)*	*Price ('000Rs) (Y)*	*XY*	*X^2*	*Y^2*
1	10	45	450	100	2025
2	16	55	880	256	3025
3	19	75	1425	361	5625
4	22	100	2200	484	100,00
5	28	105	2940	784	110,25

EXERCISES

Review Questions

1. Answer the questions briefly :
   (a) What is tabulation? Why is it necessary?
   (b) What are the differences between Mean and Mode?
   (c) How many types of central tendencies are there?
   (d) What are the measures of Deviation?
2 What are the advantages of measuring central tendencies?
3. Compute the standard deviation from the given data
15, 18, 20, 12, 10, 9, 11

4. The table below shows the relation between teachers and students of a school. Find out the nature of correlation between the teachers and students.

Classes	*No. of Teachers*	*No. of Students*
VI	4	85
VII	4	80
VIII	3	82
IX	6	105
X	6	102
XI	5	110
XII	8	112

3

REPRESENTATION OF DATA

CHAPTER

INTRODUCTION

Representation of data in a systematic and aesthetic way is an important aspect of cartography. Raw data fail to convey their full meaning. When they are arranged in a systematic way, many of their hidden characteristics come to light

The nature of data varies; so do the methods of their representation. Climatic data, like temperature, pressure, rainfall, etc., can be best represented by isotherm, isobar and isohyet; while agricultural and industrial data may be better represented by dots, symbols, colour, shading, etc

CONSTRUCTION OF DIAGRAMS

Diagrams are very effective means of attracting attention to the broad and salient features of a situation presented by a given set of time series or comparative data. The first step in the construction of a diagram is to organise the data in a tabular form which you have learnt in the previous chapter. Table gives exact values of observations, even if in summary form. But one has to read between the lines to discern a pattern or general picture. Diagrams present a general picture. The very sight of a diagram helps the viewer get the general image of the reality. However, unlike tables, only a limited set of facts can be presented through diagrams.

Bar Diagram

Bar diagrams are probably the most widely used diagrams. A bar diagram is a graph that consists of a number of bars (columns) whose length or height varies with the magnitude represented while the width remains the same. Bars may be arranged vertically or horizontally. They can be used to show changes in magnitude over time or space or in data which may differ qualitatively. As an example let us present the 'Changes in Sex Ratio in India' during the time period (1901-2001). [Table 3.1].

Table 3.1 **: Sex Ratio in India, 1901-2001**

Year	*Sex Ratio*	*Year*	*Sex Ratio*
1901	972	1961	941
1911	964	1971	930
1921	955	1981	934
1931	950	1991	927
1941	945	2001	933
1951	946		

Source : Provisional Population Totals, Paper-I of 2001, Series-I, Census of India, 2001.

Several aspects of the arrangements of the bars may be noted

1. Bars differ only in length, not in width.
2. Equal space is provided between each adjacent bar to make it easy to identify them. The space between each bar is neither too small nor too large
3. It is desirable to indicate the numerical value at the top of each bar.
4. Since the years in Table 3 1 are following a chronological order, the bars in the figure 3 1 have been presented in the same order. However, if no such order had been indicated, one could present them according to his or her objective.

Simple bar diagrams represent one variable in terms of time, space or quality. If we are

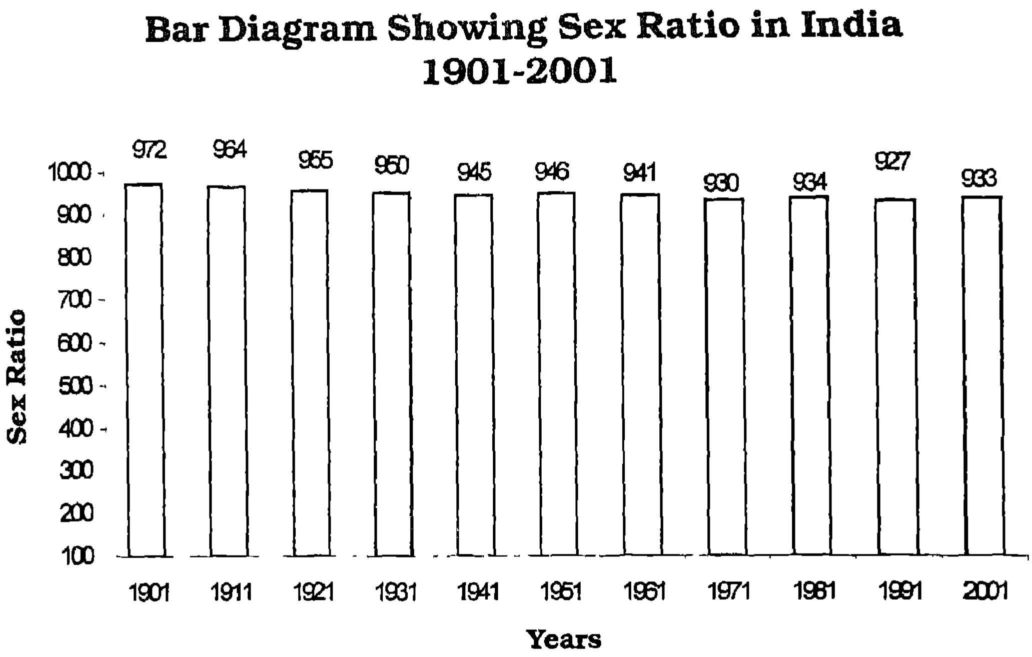


Fig. 3.1 : Sex Ratio in India 1901-2001

interested in comparing two or more sets of related data, we should go for multiple bar diagrams. Drawing of more than three adjacent bars loose the clarity which is an essential attribute of a good diagram. In double or triple bar diagrams, the bars have to be distinguished by shading or colouring. A legend or key should be in the diagram explaining the shades or colours. For example, we may be interested in comparing the level of literacy among males and females in different states of India. This can be effectively shown by a double-bar diagram (Table 3.2)

Table 3.2 **: Percentage of Literates (Sex-wise) in Selected States in India, 2001**

States		Male	Female
1	Kerala	94.20	87.86
2	Maharashtra	86.27	67.51
3	Tamil Nadu	82.33	64.55
4	Punjab	75 63	63.55
5	Bihar	60.32	33.57
6	All India	75.85	54.16

Source : *Provisional Population. Totals, Paper-I, Series-I, Census of India, 2001*

Figure 3.2 as a percentage-bar diagram clearly brings out the following comparisons :

1. Level of literacy and illiteracy among males in selected states and for India, and
2. Level of literacy and illiteracy among females in selected states and for India.

Pie or Wheel Diagram

Circular diagrams are sometimes known as wheel diagrams or pie diagrams. The basic principle underlying this diagram is that the area of the circle is made proportional to the total quantity or number represented by it. It gives a good visual idea of the fact it represents, but unlike bars, it is not easily measurable.

Pie diagram is a circle broken down into sectors. It should be used to show data in percentage and not absolute figures. Use of absolute figures would require drawing different sizes of circles. Percentage different regions can be presented by equal size circles. Generally, the largest component sector of a pie diagram is placed beginning at 12 O'clock position on the circle. The other component sectors are placed in clockwise sequence in descending order of magnitude except for

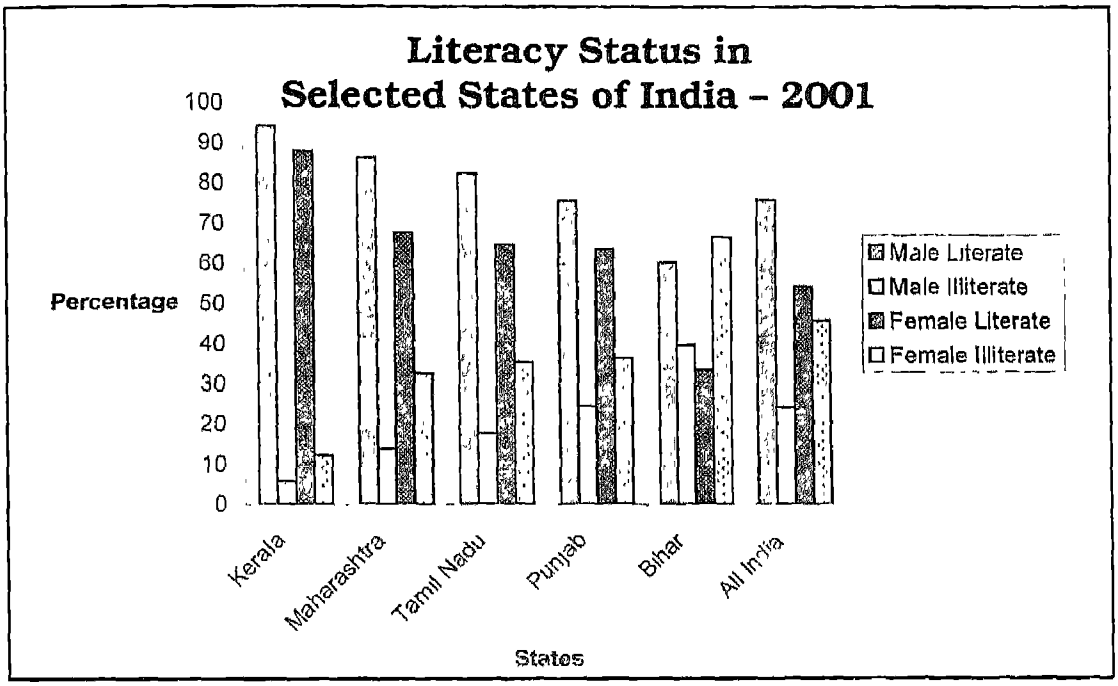


***Fig. 3.2** : Bar Diagram Showing Literacy Status in the Selected States of India - 2001*

component, 'all others' or 'miscellaneous' which is shown at the last. Each component or sector should be shaded or coloured so as to contrast with the adjacent sector.

The advantage of pie diagram over bar diagram is that it occupies less space, a fact which makes it more suitable for showing distribution on maps. Individual item shown in different sector can easily be compared

The use of pie diagram can be exemplified with the representation of the population data by religion in India (Table 3.3)

***Table 3.3* : Population by Religion in India, 1991**

Religious Group	*Percent*
Hindus	82.41
Muslims	11.67
Christians	2.32
Sikhs	1.99
Buddhists	0.77
Jains	0.43
Others	0.41
Total	100

Source : *Census of India, Series 1, Paper I of 1995 (Religion)*

A circle represents 360° i.e., 100 % represents 360°. So, whenever percentage figures are to be represented by the pie diagram, that percentage is multiplied with 3.6 to get the angle of the sector And the sum of all the sectors will come out to be 360°.

FLOW MAP

The term 'flow map' conveys the idea of movement and hence these are dynamic maps. Data on movement of people and commodities, etc. can be represented by flow diagrams. Since the movement of people and commodities takes place in a region between places along the transport lines, two features of such maps are important : (i) The direction, and (ii) the number of people or the quantity of commodities For the construction of these maps the following procedure is adopted :

- A map of the selected area is drawn, showing important places and the transport routes such as roads, railways and waterways, etc.
- Data on the movement of people or commodities from the place of origin to its destination are compiled.

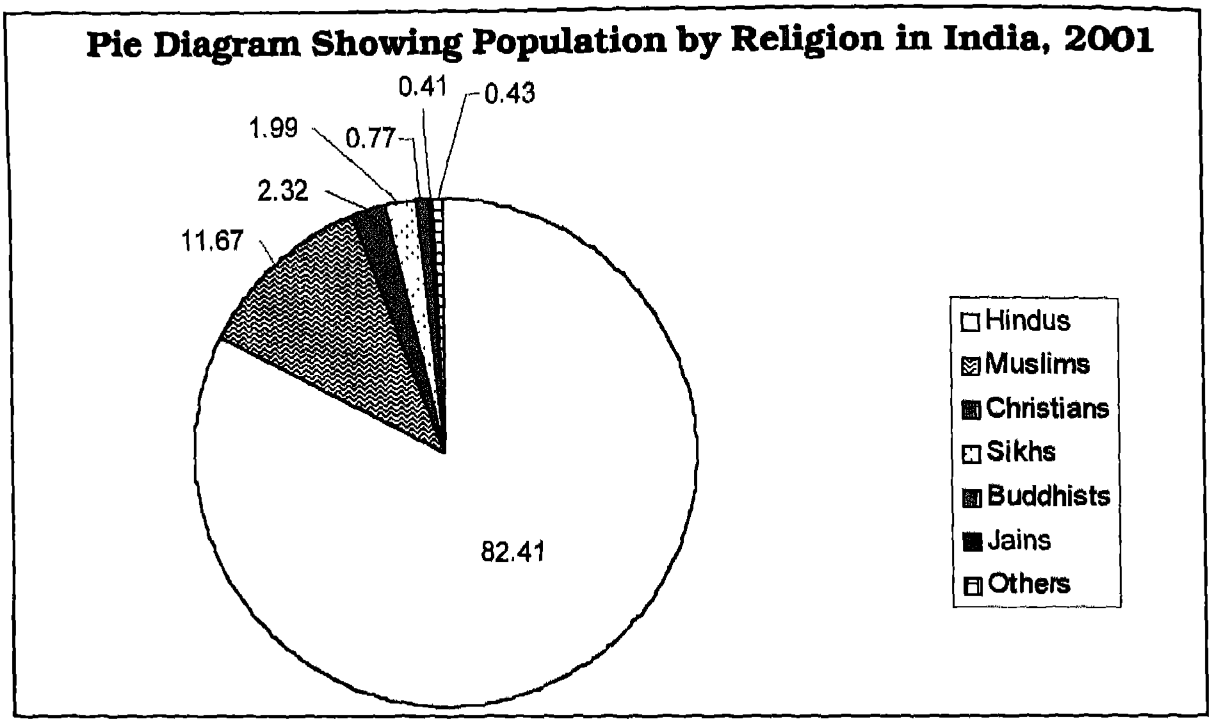


***Fig. 3.3** : Population by Religion in India, 2001*

- A suitable scale is chosen to represent the number of people or quantity of the commodity by varying the thickness of line proportional to the number of persons or the quantity of goods.

Lines of appropriate thickness are drawn on either side of the transport route to show the movement in each direction, from the origin to destination or the direction of movement. Thickness of lines indicates the volume of flow.

Likewise, at places where the flow lines converge, the variations in the thickness of lines would serve to distinguish the places according to their levels of importance. These places of convergence of people and commodities are called **nodes**.

From Fig. 3.4 we can see that Karnal (in Haryana) is an important place where convergence of people is more than that in other places. The intensity of movement is high along the road linking Karnal and Panipat with Delhi further south.

Flow map can also be used to delineate spheres of influence of places which function as nodal centres. This is done by closely examining the thickness of the flow lines from the nodes outwards. The abrupt change in the thickness is marked on the map in all directions. Often, the thickness would increase after some distance as one approaches another important place to which people and commodities move This would serve to divide the study area into a number of nodal points and their spheres of influence (nodal regions).

In the case of commodity flow maps, the flow lines can be further sub-divided according to the type of commodity and the quantity moved. Unlike the data on land use, population, etc., the data on the movement of people and commodities are difficult to obtain. The study of flow patterns constitutes a specialised theme in Geography.

THEMATIC MAPS

Thematic maps are those maps which are prepared based on one particular theme such as the distribution of population in Rajasthan, or a map of India showing the distribution of atmospheric pressure on a particular day. Such maps may also be drawn with

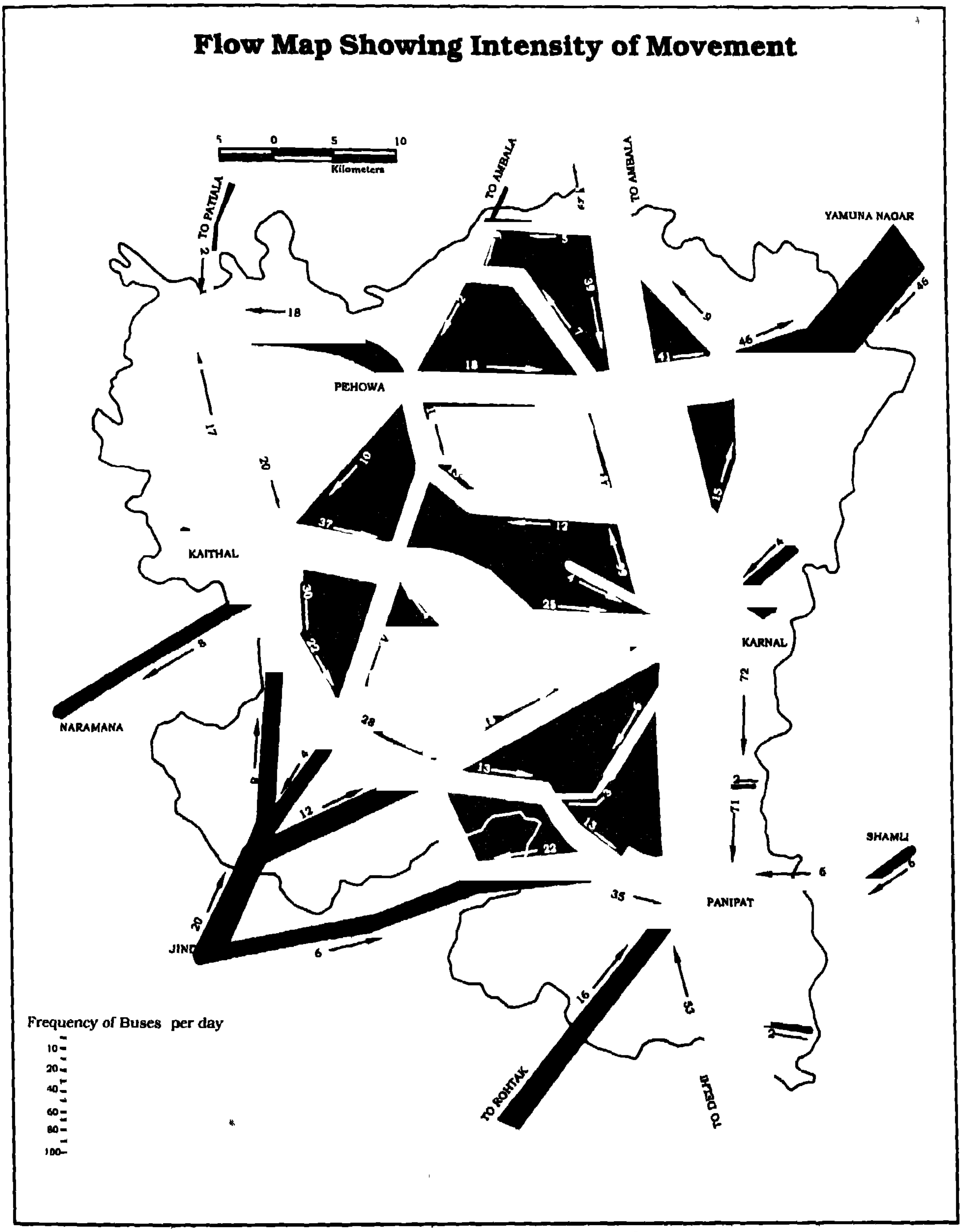


Fig. 3.4 : Karnal District – Frequency of Buses

a combination of themes These maps are very helpful in depicting the distribution pattern of phenomena over time and space

Dot Method

This is the most common method for showing the distribution of rural population and units of settlements. This involves the use of dots of uniform size, each dot representing certain number or quantity. Fig 3.5 depicts the use of dot method in showing population distribution of Rajasthan

While making dot maps following points should be kept in mind .

- Placing of dots requires great care and precaution Dots should not be placed over rivers and water bodies, etc. To have an idea of such areas physical and relief map of the area should be consulted
- The total area covered by dots should not exceed 15-20 % of the map area
- The size of dot should wisely be selected by keeping in mind the maximum and minimum quantities to be shown, the size of the map and the aspect to be represented

Advantages

- Dot method exhibits a more vivid and exact picture of the distribution pattern because

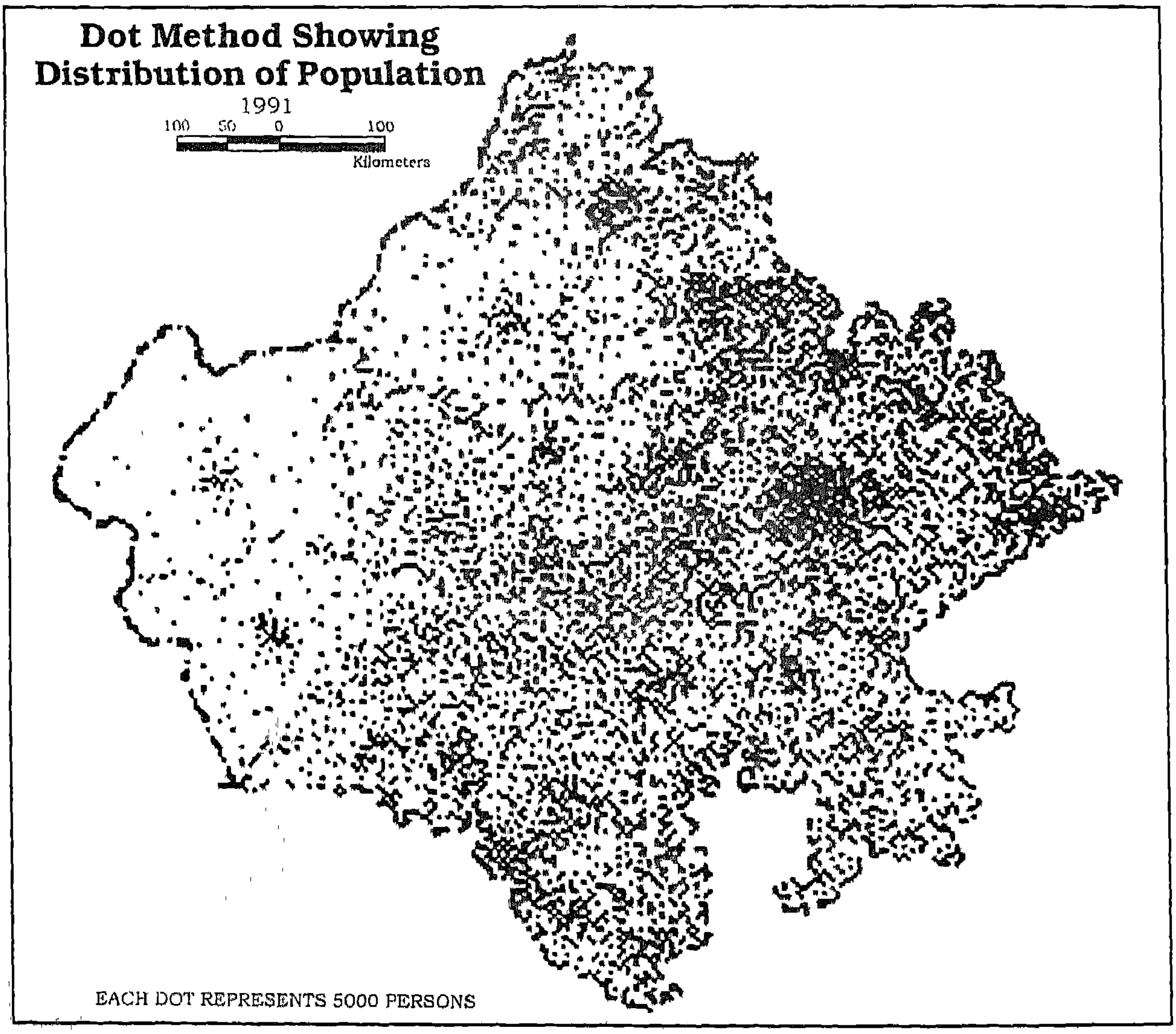


Fig. 3.5 : Rajasthan : Distribution of Population, 1991

the darkness of the map is always proportionate to the intensity of distribution

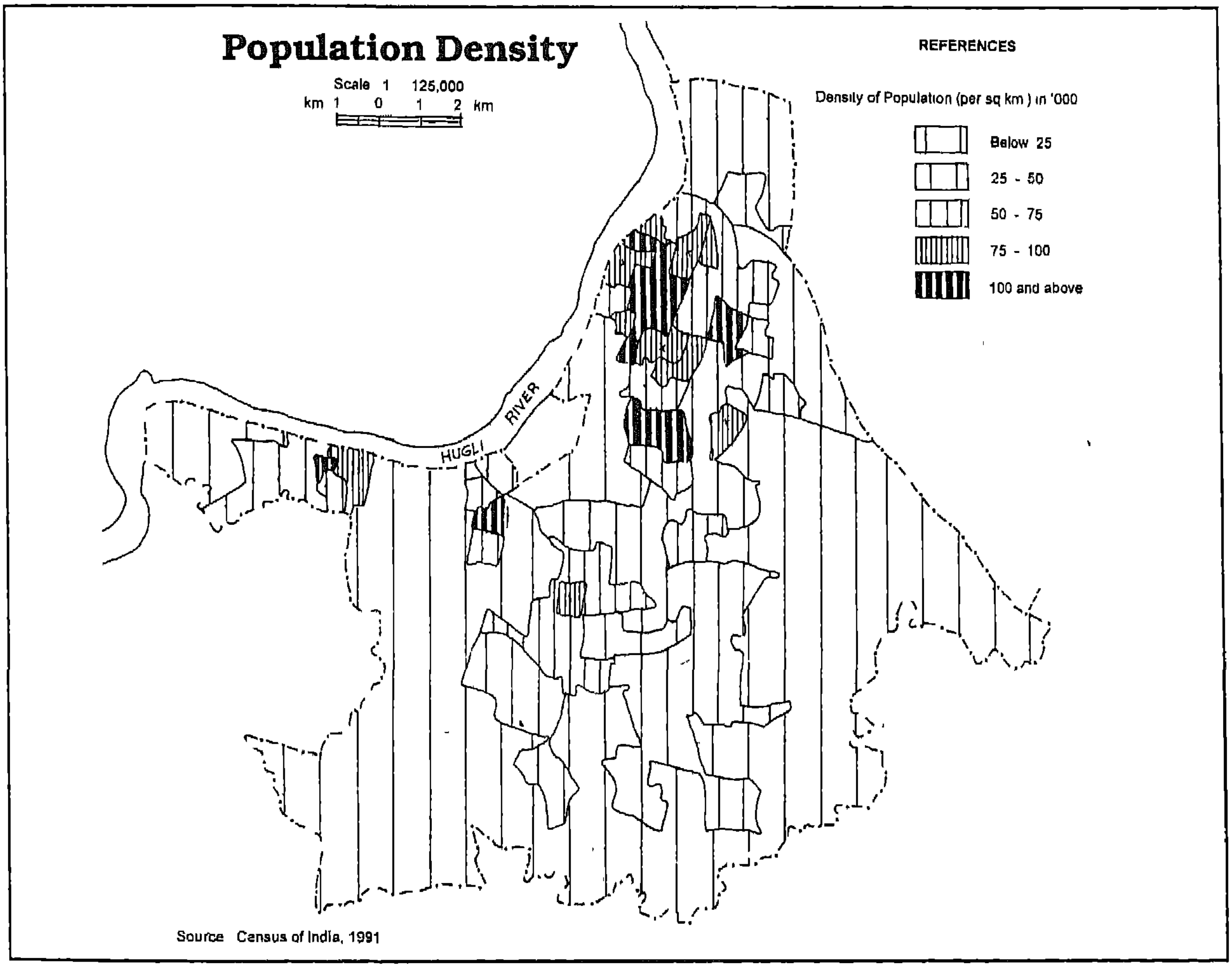
- It is easily and exactly commensurable
- The dot map may be transferred into an isopleth or choropleth map but the latter cannot be transformed into the former.
- The dot method can be used for many purposes than it would be possible by other methods. For example, besides showing the distribution of rural population and units of settlements, etc., dots may be used to show other distributions also

Limitations

- This method cannot be used to show ratios and percentages for which choropleth and isopleth maps are preferred.
- Dot method is not appropriate for qualitative attributes.

CHOROPLETH METHOD

The Choropleth method is used to show the distribution of a given element by different shades or colours to represent varying intensity or density A suitable scheme of shades of various intensities is shown in the index of the map. The lighter shades represent lower densities and darker shades represent higher densities. Unit area to be taken into account will have to be selected first. For example, if the unit area is 'state' in India, then a map of India with state boundaries would be needed Similarly, in a global distribution, a world map with national boundaries would be needed. Fig. 3.6 shows the use of Choropleth technique.



Source Census of India, 1991

Fig. 3.6 : Choropleth Method Showing Population Density

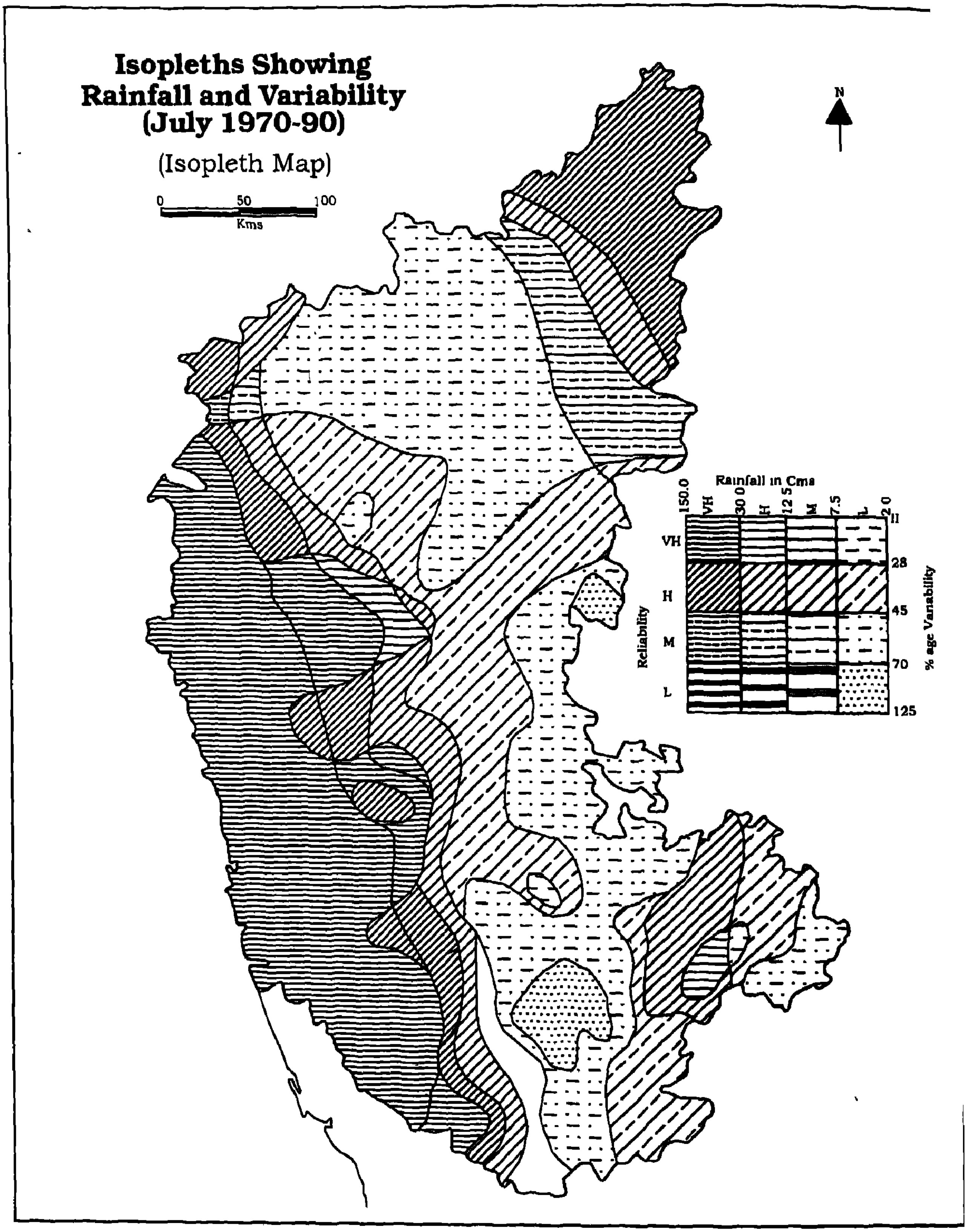


Fig. 3.7 : Karnataka – Rainfall and Variability (July 1970-90)

Advantages

- Ratios and percentages are better represented by Choropleth method
- Density of the represented element is clearly explained by this method, especially in relation to its surroundings.
- It is easy to draw as it is based on administrative units.
- Sometimes, absolute numbers can also be shown by this method.

Limitations

- At the boundary of two differently shaded regions, there is an abrupt change in density which may not be always true.
- Wastelands such as deserts, marshes, hilly regions, etc all disappear beneath the shading.

ISOPLETH METHOD

Isopleth maps use the lines of equal value called isolines to express quantity, intensity and density. The contour lines are typical example of isopleths. The spacing of lines expresses the rate of spatial variation. If the lines are wide apart, the change is gradual and when they are closely spaced, variation is sharp or abrupt Fig. 3 7 shows the use of Isopleth technique in showing the distribution of rainfall and its variability in the state of Karnataka

Advantages

- This method is commonly used for showing isotherms, isobar and isohyet maps, because these elements are uniformly distributed over wide areas.
- It is used for showing ratio and percentage.
- It is also used to show population density, average expectancy of life and mortality, ethnographic distribution and rate of fertility.

Limitations

Use of isopleth method is limited by ·

- The non availability of information.
- The extent of transitional belt. When the data of isopleth are not in detail, they will give a highly generalised or erroneous picture of the facts.
- It is very complex method and needs a lot of time and concentration.

EXERCISES

Review Questions

1 Answer the questions briefly :
   (a) What are the salient features of maps and diagrams? Give suitable examples.
   (b) What are the salient features of a flow map?
   (c) What are the points to be kept in mind while using dot method?
2. Write short notes on ·
   (a) Merits and demerits of Dot Method,
   (b) Limitations of Choropleth technique; and
   (c) Merits and demerits of Isopleth technique.
3. In the following table land use data of India is given.

Land Use	*Area (in Million Hectares)*
Net sown area	1,000
Cultivable waste	360
Current fallow	80
Others	390

Represent the above data by a suitable diagram

4. Data showing population of some selected states of India are given below.

Population in Selected States of India

Sl. No.	*States*	*Population 1991*	*Per cent to Total Population*
1	Uttar Pradesh	139,112287	16 44
2	Bihar	86,374,465	10 21
3	Maharashtra	78 937,187	9.33
4	West Bengal	68,077,965	8 04
5	Andhra Pradesh	66,508,008	7.86
6.	Madhya Pradesh	66,181,170	7.82
7.	Tamil Nadu	55,858,946	6 60
8.	Karnataka	44,977,201	5 31

Show the above data by bar diagram using population in percentage Give reasons why bar is the most suitable method to depict this data

4 CHAPTER

USE OF COMPUTER IN DATA PROCESSING AND MAPPING

Computer is an electronic device that processes information at high speed with accuracy The most powerful computers can perform billions of calculations or arithmetic operations per second. This device is capable of solving problems or manipulating data by accepting the same performing arithmetical operation (using arithmetical instructions, e g., addition, subtraction, multiplication and division) or logical operations (using logical operators 'and', 'or', 'not and', etc.) of the data, and supplying the results of these operations In general computer can process numbers, words, still pictures, moving pictures and sounds The computer uses electronic current to carry information. To enable a computer to process information that is not numerical such as words, pictures or sounds, the information is digitised.

It is necessary for us to know and understand what a computer can not do. A computer can not do thinking for us. Computers can only follow specific, logical steps based on the information we humans enter. Thus, a computer can only act on the basis of information we put in it. A computer does only what it is told, either by programs (a set of instructions) or by a human operator.

PARTS OF COMPUTER SYSTEM

A computer system consists of two basic components :

1. Hardware
2. Software

I. HARDWARE

It is the physical part of computer system and consists of electronic, magnetic and mechanical devices. A computer system has following main hardware units :

1. ***Central Processing Unit (CPU) :*** It is the nerve centre of any digital computer system, it coordinates and controls the activities of all other units and performs all the arithmetical and logical process to be applied to the data. CPU has three separate hardware sections : internal memory, arithmetic unit and a control section Chip (thin silicon wafer containing a large amount of integrated electronic circuitry) is the building block

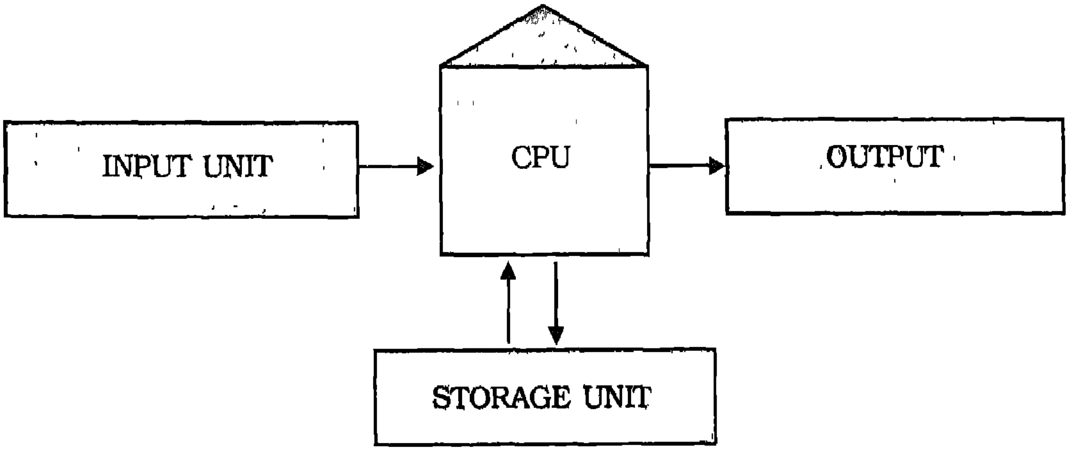


Fig. 4.1 : *Processing of Data in Computer*

of a computer and performs various functions, for example, doing arithmetic operations, serving as the computer's memory or controlling other chips.

2. ***Visual Display Unit (VDU) or Terminal :*** Like Television, display unit consist of a Cathode Ray Tube, which is used to display characters or graphics representing data read from the main memory of a computer.
3. ***Input and Output Devices :*** Input device like keyboard, is used to enter data and programs into the computer memory. Similarly, since all the data and programs within a computer are stored as electrical impulses in a coded form, output devices like printers, plotters, etc are employed to transcribe this data into information (for example characters, drawings or graphics) that can be used by human beings.
4. ***Storage Device :*** A computer consists of a number of storage devices like Hard disk, floppy, tape, Magneto Optical disk, Compact disk (CD), Cartridge, etc; which are used to store both data and program instruction. These devices vary in their capacity of data storage, from megabytes (MB) to gigabytes (GB).

2. SOFTWARE

In its most general form, software refers to all programs, which can be used on a particular computer system. More specifically, software means all those programs, which in some way can assist all users of a particular type of computer to make the best use of their machine. Software governs the operation of a computer system and makes the hardware run. The software for a computer system may be classified as :

- Applications Software
- System Software

Application Software

There are two types of application software : First type of application software relates to data base management, business graphics and words processing, covering a broad range of functions used by most business houses and many individuals.

Second type of applications software provides specific professional or technical applications for specific kinds of business. For example, software specifically designed to be used by medical doctors, dentists, architects and engineers perform very special tasks.

The categories of broad-range applications software meant for personal use and business include :

- Accounting — general ledger, payroll, invoicing, etc
- Communications — electronic mail interaction with central office mainframe computers, connectivity with commercial data banks, and other services offered by information utilities.
- Data base management — organising data files for central access, retrieval and update, compiling statistics, plot trends and market analyses.
- Educational Programs — learning through games, tutorials, simulations, etc.
- Graphics — displaying colour graphics and charts, producing colour slides and other visual aids.
- Programming — translating a problem from its physical environment to a language that a computer can understand and obey.

System Software

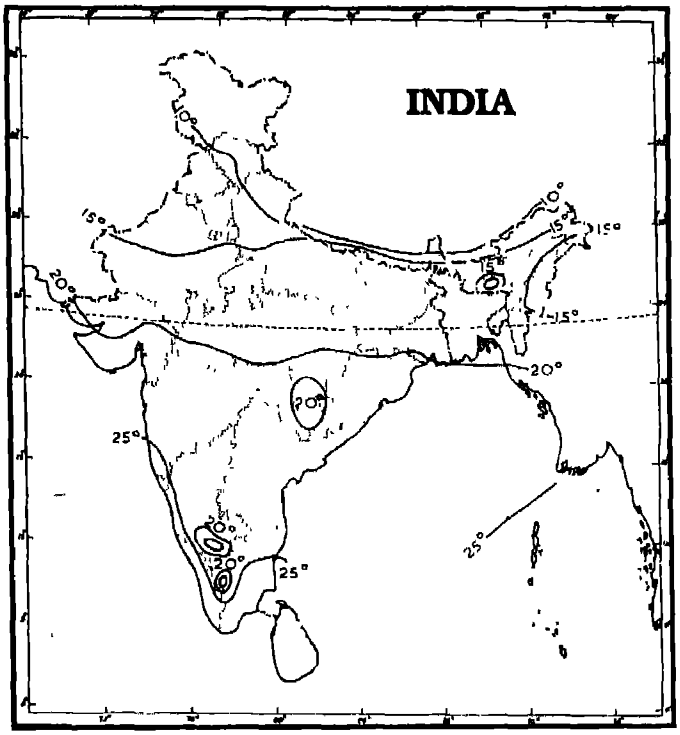
It signifies program that runs the computer system and helps the applications programmer in doing his/her task. System programs consist of the following :

Operating System (OS) : Software that controls the executions of computer programs and provides scheduling, debugging, input /output control, compilation, data management and related services. Popular types of operating system include DOS (Disk Operating System), UNIX and its variants, VMS (Virtual Memory System), Microsoft Windows, etc.

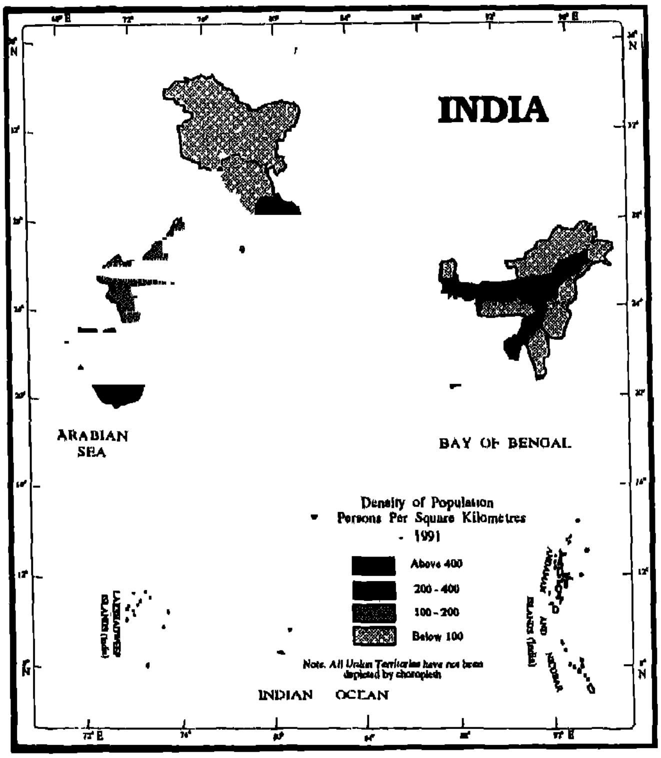
Compiler

Graphic Support Programs

Mathematical routines — short sets of program codes that perform mathematical calculations. Before you use computers you should be



A Traditionally Drawn Map


INDIA
ARABIAN SEA
BAY OF BENGAL
Density of Population
Persons Per Square Kilometres
- 1991
Above 400
200 - 400
100 - 200
Below 100
Note. All Union Territories have not been depicted by choropleth
INDIAN OCEAN
LAKSHADWEEP ISLANDS (India)
ANDAMAN AND NICOBAR ISLANDS (India)

A Computer Generated Map

Fig. 4.2 : Maps : A Comparative Picture

familiar with some common terms used in computer Given below are some of the useful terms.

RAM *(Random Access Memory)* · Memory into which data can be written and from which data can be read.

ROM *(Read Only Memory)*. Memory containing information which is present and permanent and which cannot be written but can only be read by program routines.

CACHE · Most frequently accessed memory sites in files.

Modem : A device that allows computer users to communicate with one another over telephone lines.

Network : A system consisting of two or more computers connected by high-speed communication lines.

Peripheral equipments : Consisting of input devices, output devices and file storage devices.

URL *(Uniform Resource Locator)* : A computer address that is registered in a central location.

Browser Software · Software that connects a computer operator to a URL containing information that the operator wishes to examine.

Multimedia : A computer controlled combination of text, graphics, sounds, photographs, film and other types of media.

APPLICATION OF COMPUTER IN DATA PROCESSING AND MAPPING

There is a saying, *Biography is about chaps, and Geography is about maps.* Mapping is an integral part of Geography learning and teaching. Use of computer in mapping has revolutionised this field. Digital methods are being extensively used for map-making facilitated by computers, and hence, the computer-Aided Design (CAD) and computer-Aided-Management (CAM) have emerged as new fields of study.

Digital techniques of mapping consist of following operations :

1. Data Capture or Data Acquisition

Data about real world can be acquired from various sources. Field observations by traditional methods like aerial photos, GPS (Global Position System), satellite imageries, existing old maps and field manuscripts records properly verified are some of them. The hand copy, field records, maps and aerial photos are converted into digital form through scanning (rasterisation) and digitisation (vectorisation), which can be processed further according to needs.

2. Geo-coding or Geo-Referencing of Raster Image

Scanned raster images and satellite imageries are corrected for distortions by matching them with ground control points (GCPs) occurring in an image. GCPs are features of known ground location that can be accurately located on the aerial photo or satellite imagery. GCPs are located both in terms of their image coordinates (column and row numbers) on the distorted image and in terms of their ground coordinates (typically measured from map or established on the ground in terms of latitude and longitude with respect to a particular projection system, say UTM or Polyconic). A least-square regression analysis is done to interrelate the geometrically correct (map) coordinates and distorted image coordinates. Then, image is warped to have correct geometrical relationship with its corresponding ground situation

3. Digital Fair Mapping

Geo-coded raster image is used as a backdrop to draw point, features, line features and aerial features and annotate them with proper symbols and texts. Alternatively, the above features or the raster image may simply be digitized without using symbols to create cartographic database. The digital map may be subjected to automated cartographic processes, like generalisation, classification, etc.

4. Map Reproduction

The digital map prepared through digitization of raster images in computers is used either to generate colour separates on paper or film through printer, or it may be used to prepare colour composites on films through printer or it may be used to prepare colour composites on films for each colour, e.g cyan(c), magenta (m), yellow (y) and black (k). The colours separate on a paper or films are photographically merged to generate the colour composites. These colours are used to prepare plate for offset printing

The above-mentioned techniques have immensely contributed to map making in recent times. Maps which are produced using these techniques are not only sharp and accurate but can be produced very quickly.

EXERCISES

Review Questions

1 Answers the questions briefly·
   (a) What are the main components of a computer?
   (b) What are the main advantages of using a computer?
   (c) What are the storage devices in a computer?
   (d) What is an Operating System?
2. Compare system and application softwares.
3. Write short notes on the following :
   (a) Central Processing Unit
   (b) RAM and ROM
   (c) Digital mapping
   (d) Grand Control Points (GCPs)
4. Write an essay on Geo-referencing

Unit IV

FIELD STUDY OR SPATIAL INFORMATION TECHNOLOGY

5

FIELD SURVEY AND ITS RELEVANCE IN GEOGRAPHY

CHAPTER

Geography is a field-oriented science. Field survey helps us in understanding the intricate relationship between human and environment. The maps provide only second hand information. In fact, a map becomes dated as soon as it is brought out For current information field survey is a necessity.

The secondary data compiled and processed from other sources often proves inadequate for geographical studies Thus arises the need for field survey which gives first hand information. The two basic steps in field survey are : collection and processing of data

Differences in social, economic and cultural characteristics between and within regions change with time. To some extent, the satellite imageries, discussed earlier, have filled the gap. But even satellite imageries require ground checking. Field survey therefore continues to be an important source of latest information.

Students of geography should have some training in the local geography of the regions where they live. Such studies would help them derive certain general principles which can be applied to understand other regions. Field surveys are essential methods to conduct such studies covering the entire phenomenon or a part of it

Let us use an example to better understand the process of field survey. Suppose, there are 500 plots of land in a village. To find out the quality of soil, the field worker can visit each of the 500 plots. Alternatively, he can select just 50 plots randomly. As stated earlier randoms can be drawn by selecting every tenth village from a list of 500 villages placed alphabetically. The results derived will be based on 10 per cent sample and would be quite reliable if the samples were drawn without any bias. To develop a geographical outlook, classroom study of geography should be supplemented by field studies of the type mentioned above.

The approach to field survey varies depending on the purpose of study. The design of field survey includes selection of area and collection of whatever secondary information, maps, etc. are available. The data can be plotted on a base map. Questionnaire and schedules can be prepared for data collection Large scale topographic map of the area may be consulted for understanding the characteristic of the area in terms of relief, broad land use, settlement pattern, transport and communications.

MAP ORIENTATION

Orientation of a map facilitates comparison of features shown on the map with those present on the surface of the earth. Map orientation means the adjustment of north on the map with that on the ground. Map orientation can be done by several methods. One way to do this is to compare some salient features on the map with corresponding features on the ground. A rough estimate can be made with the help of the inclination of sun's rays For more precise orientation, one must take the help of a compass

SKETCHES

Sketch is a rough drawing of the area under study. It is, however, not a map because it is not drawn to scale. Sketches should be large and clear. Exaggerated sketches of small areas can be made to facilitate clear understanding of the phenomena present there. The distinguishable features of the area are shown by appropriate symbols. Explanatory notes can be written to facilitate identifications of features.

ARRANGEMENT AND EQUIPMENTS NECESSARY FOR FIELD SURVEY

Before going to the field, library study of the relevant area is necessary. The information so derived acts as a base for the study. It gives a prior view of what to expect in the field. One should not forget to make appropriate arrangements for stay in the area.

The following equipments have to be taken while going on a field survey

(a) A notebook with necessary drawing materials
(b) Surveying instruments according to nature of work and the instructions issued by the supervisor
(c) Topographical survey maps of the area to compare features depicted on them with those in the field
(d) Camera for taking photographs of typical features
(e) Binoculars to facilitate distant view of the landscape
(f) Hammer to cut rock specimens
(g) Soil sampler to take sample of soils
(h) Bags to collect specimen of rocks, etc.
(i) Other necessary items

DATA COLLECTION

Field survey involves collection of both qualitative and quantitative data. The nature of the data to be collected depends on the objective of study. There are two methods of collecting data: observation and questionnaire.

Observation

Observation means looking around, talking to the people and noting down the observed or heard information. In Social Sciences this method is of paramount importance. The quality of the information depends on the training and background of the observer. A cautious and conscious observer keeps his eyes and ears open for relevant details. The recording of the data has to be tabulated and tally bars can be used to note down the similarity and differences observed.

There are two kinds of elements in the topography ,

(a) The fixed elements
(b) The dynamic or movable elements.

Buildings, drainage system, major physical features, fields and fences, means of communications, canals, pit heads, mines, etc. are fixed elements. The crops, livestocks, wagons, vehicles, machines and people are mobile elements. The fixed elements should be marked on large scale maps using conventional signs.

The observation can be covert (hidden) or open (known). When the observer interacts with the respondents being observed, he is called participant observer and this observation is called participant observation.

Questionnaire

Questionnaire method involves putting previously framed questions to the selected persons. The questionnaire can be structured or un-structured. When a structured questionnaire is administered, there is no scope for manouvering on the part of the researcher. He has to mechanically put the questions and note down the answers. In un-structured questionnaires, the order in which questions are put can be changed according to the need of the surveyor.

A map or sketch can be drawn while recording the answer. As a guide each question includes, in brackets, some remarks on how one should process the answers.

There are several types of questions. Which type should be administered depends on the nature of data required and the background of the people to whom the questionnaire is administered.

The different types of questions include :

(a) Simple choice questions
(b) Multiple choice questions
(c) Semantic scale questions
(d) Open ended questions.

Simple Choice Questions

Simple choice questions can be answered in Yes or No. For example, the response to the question : Do you practise agriculture?, would be simple Yes or No. These questions are useful for collecting information related to occupation of people.

Multiple Choice Questions

In case of multiple choice questions, some answers are given, but only one of the answers is correct. Example : Why is the sugar factory in region 'X' located at place 'A'? The probable answers are :

(a) Availability of land
(b) Availability of labour
(c) Availability of capital
(d) Access to market
(e) Personal preference for residence of owner/ entrepreneur
(f) Any other reason.

Only one of the above answers mentioned is correct. But the answer will give an idea about the consideration that has been instrumental behind setting up of a factory.

Semantic Scale Questions

The degree of feeling of the respondent is noted down on a point scale. How strongly the respondent feels in favour or against the issue is to be noted down.

For example : How do you rate the anti-poverty programmes implemented by the government?

(a) Very good
(b) Good
(c) Satisfactory
(d) Bad
(e) Very bad

The rating answer of the respondent is noted down. This kind of information will give an idea about the public opinion regarding a policy or a programme.

Open Ended Questions

In this case, questions are administered and the answers as given by the respondents are recorded.

For example : What steps should the government undertake to eradicate poverty?

The answers will vary from person to person depending upon his personal, social and economic background.

TABULATION AND ANALYSIS OF DATA

The collected data has to be organised, processed and interpreted to provide the findings of the field survey. The tallymark method and tabular methods are the most common ways of organising and summarising the data.

Tallymark Method

This method provides the enumerator the means to quantify the data under different heads or groupings. The tallymark method can be explained by the example. In this case suppose, in a village there are 100 households and the enumerator is interested in knowing the major crop grown by the households. He can follow tallymark method to generate the following data ·

Major Crop Grown	*(Tallymark) Number of Household*
Rice	卌 卌 卌 卌 |||
Ragi	卌 卌 卌
Pulses	卌 卌 ||||
Cotton	卌 卌
Oilcrop	卌 ||||
Coconuts	卌 ||||
Uncultivated	卌 卌 ||
Jowar	卌 |||

Each tally (line) represents one household. Five tallies make a group which is represented by four vertical lines and one diagonal line as illustrated above.

Even in questionnaire survey, tallymark method can be usefully applied. Simple choice questions, multiple choice questions and even semantic scale question can be enumerated by tallymarks

Tabular Method

This method is the most common one for collection, organisation and summarisation of qualitative as well as quantitative data. In this case a table is made along with the frequency of the attribute or characteristics of findings. One can derive tables for tallymark data also.

The organisation of compiled data into tables helps us to create various types of diagrams and maps. These representations of the data add simplicity to the analysis and makes it readily understandable. Following are the procedures for field survey :

(a) Defining precisely specific problems
(b) Scanning of spatial variations
(c) Evaluation of the collected data/ information available in published/ unpublished form
(d) Finding correlation among the variables selected for study
(e) Identification of distinctive areas within the region
(f) Formulation of adequate and well-prepared programme for area study
(g) Selection of suitable methods and approaches for specific areal observations
(h) Areal observation in general
(i) Analysis of data and information collected through field study; and
(j) Presentations of the derived results and conclusions with critical analysis and interpretations of the various facts derived from field observations and all other relevant and reliable sources.

The following examples of field studies provide an idea of the design and procedure involved in field survey. It is expected that with the help of your teacher, you would select one of these or similar other topics that appear interesting to you.

LAND USE SURVEY

The purpose of land use survey is to find out the current uses of the land and the implications of uses for soil productivity, environment, ecology and socio-economic well-being of the people. We start with a cadastral map of the village to be surveyed. Such maps show the field number and boundaries of each field (Fig. 5.1). Types of land uses are then plotted on the map as one moves from one field to other. Code number can be used to denote specific uses, for example, **W** for water bodies or **P** for paddy and **Wh** for wheat and so on.

On a different copy of map, soil types are marked. The surveyor enters on it the general character of field in terms of slope, drainage and irrigation. Next step is collecting information from the farmers cultivating these fields through a questionnaire schedule.

Schedule for Collecting Land Use Data by Interview

Sl. No.	*Field No.*	*Name of the Farmer*	*Area in* hectare	*Type of Soil*	*Crops grown*
				Red, black, loamy	rice, jowar, wheat
1.					
2					
3					
4					
5					
6					

Foot-note 1. Tabulate the crop actually grown
2. Ask the farmer about the number of times he irrigates the land in a given time and also about his sources of water for irrigation.

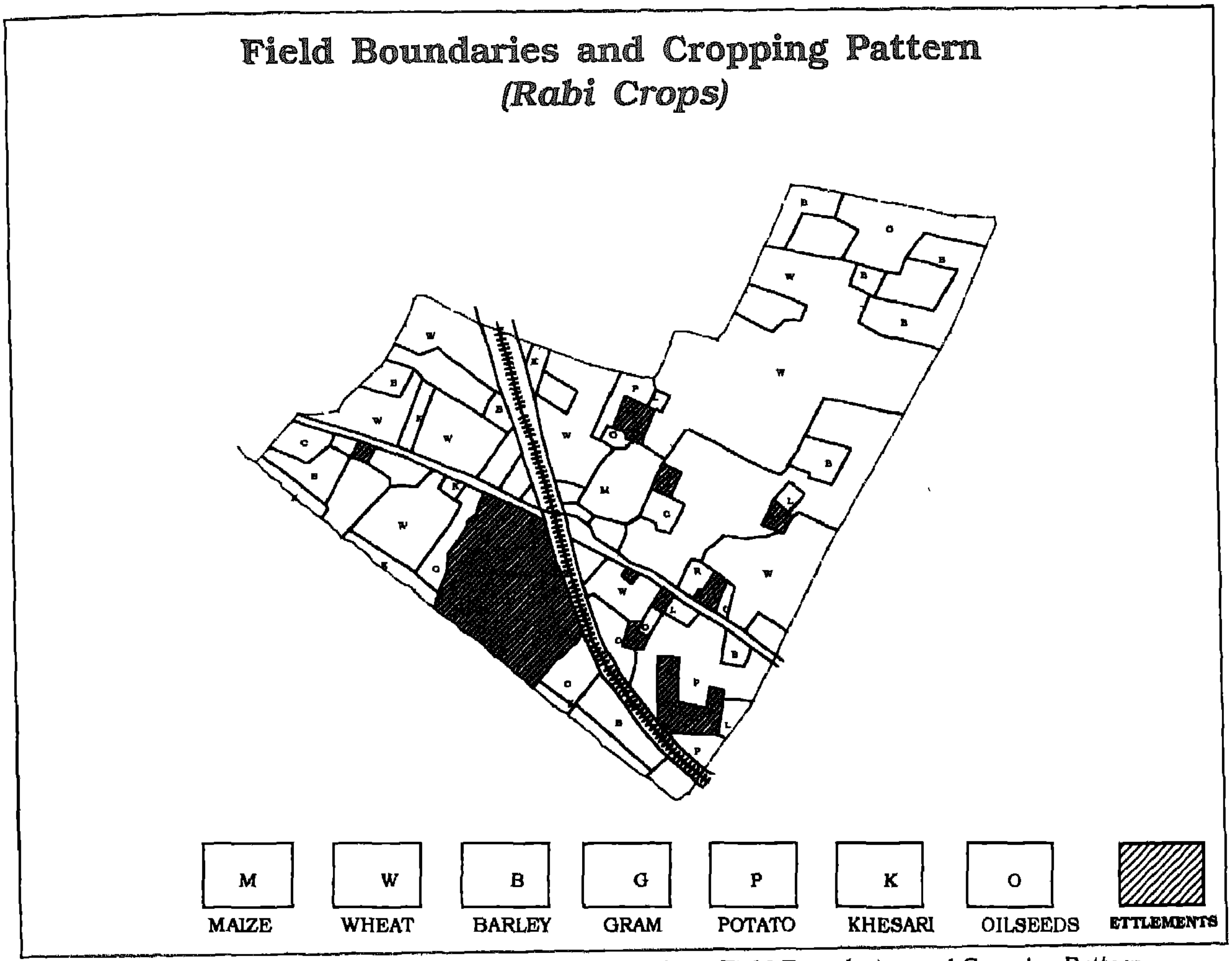


***Fig. 5.1** : Village Majhanpura, Saran District, Bihar. Field Boundaries and Cropping Pattern (Rabi Crops), 1983-84.*

The next step is proper tabulation of data collected by various groups of students and the final step is preparation of a land use map. Colour or shadings can be used to show crops, irrigation practices, etc. When the land use map, soil map, and landform maps are super imposed on each other, we can get a composite map that shows relationship which exists among them. Analysis of maps and tables is presented as the final report of the field survey enclosing the maps and tables in appropriate sections of the report.

Land use survey can be taken up in urban areas also. Built up area, transportation networks, agricultural land, urban forestry land, commercial land, water bodies, etc. can be noted down. In this exercise the extent and area of the plots become important.

CASE STUDIES

Study on Ground Water Changes

As all of us are aware that water is very important resource for our existence, so are the sources of water. The upper level of sub soil water is known as water table. Depth of water table determines general water supply of a region. The depth of subsoil water is determined by measuring the level of water in the wells of the region by a tape. At times of boring, pipes are used to measure the depth of water table. This method is costly and can be practised by mechanics. The level of water changes according to rainy and dry seasons. Thus, the data should be dated. If possible the depth of water in wells should be measured in different seasons and the measurement can be

***Fig. 5.2** : Nursery for Urban and rural forestry*

recorded on the map. If the data are adequately available, water table contours showing the depth of water table in the region can be drawn. Detailed ground water maps are helpful in planning the setting up of tubewells in the region for irrigation. Questionnaire schedule can be used for determining the temporal changes in ground water level and to ascertain the causes behind it.

Survey of Environment Pollution

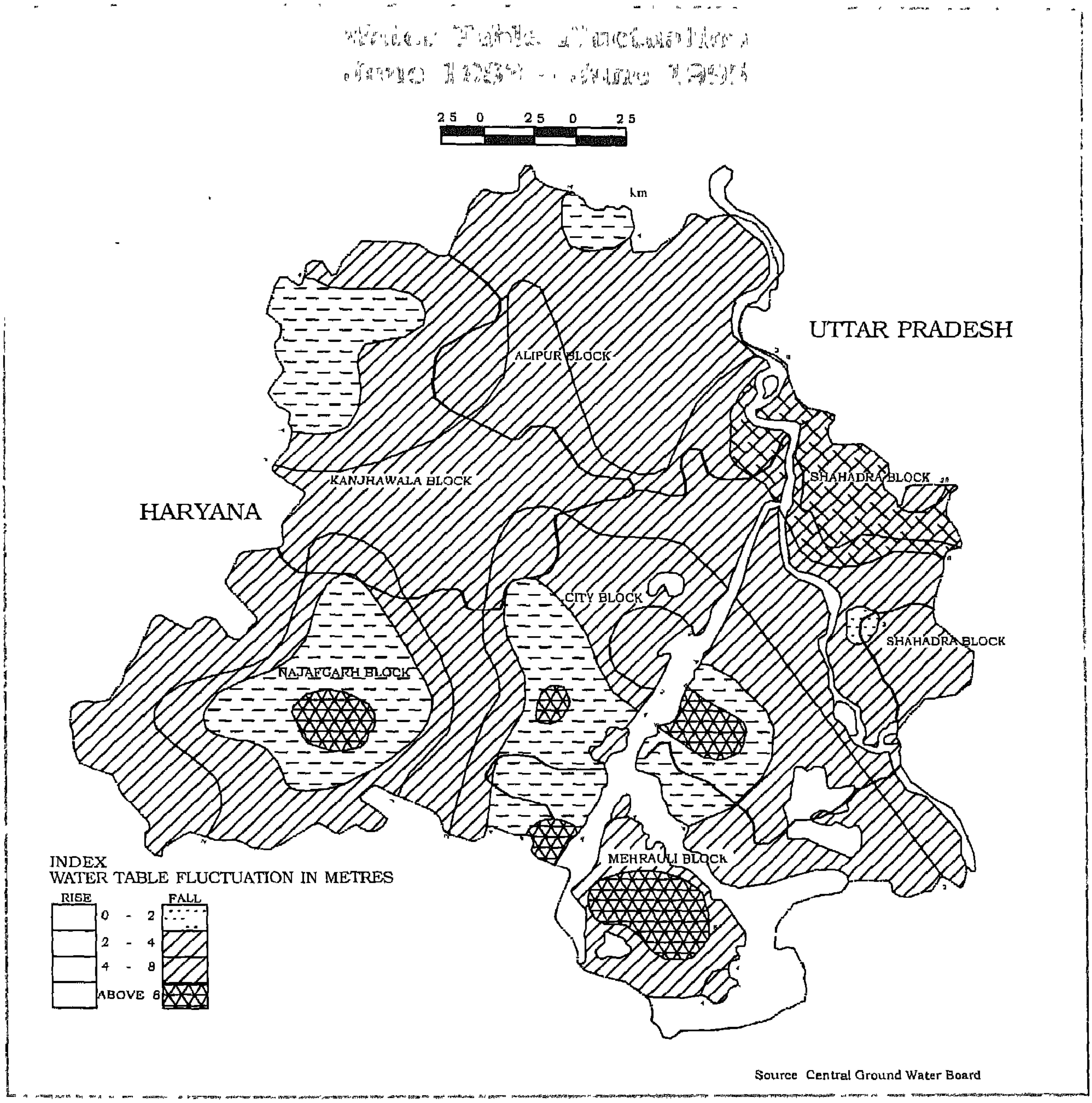
Environmental pollution includes soil pollution, water pollution, air pollution and noise pollution. Let us take up the field study of soil pollution. Causes of pollution and solid waste contamination can be ascertained through interaction with the residents of the area. The polluting unit and its effect on the surroundings, the hardships of people and deterioration of soil in the adjoining area can be found out by talking to the people.

The field surveyers have to look at the solid waste management techniques used, the role of various stakeholders, the initiatives taken to solve the problem and progress made so far.

Air and water pollution can also be ascertained but it requires complex scientific techniques which are beyond the scope of this book. The preliminary studies however can be done in this regard too. The effect on the health of the local people can be ascertained. In pollution studies, the polluted area has to be demarcated and groups of field surveyers have to go not once but several times to get necessary information.

Field Study of Poverty

A socio-economic study of poverty in a given area can be undertaken by senior secondary students. It can be a study of each household in slum areas. Infromation on average income, calorie intake, medical facilities available and occupation, etc. have to be ascertained. The distribution of population, human habitations, food, clothing along with the social and cultural relations in the area between various income groups can be found out by carefully worded questionnaire. The initiative of the government, various poverty alleviation schedules, their impact on people in the area can also be



Source Central Ground Water Board

Fig. 5.3 : Water Table Fluctuation

ascertained by effective questionnaire. The analysis and interpretation of the data have to be done to infer the poverty situation in the area.

Study of Soil Degradation

To carry out this study, the soil sampler instrument can be used to take soil samples at different soil horizons. The soil samples can be taken from different plots of the area. The samples should be put in different specimen bags or glass tubes which should be numbered and named after the area from where the samples have been collected. The thickness of top-soil, sub-soil, hard pans and parent rocks, etc, should be distinctly shown by

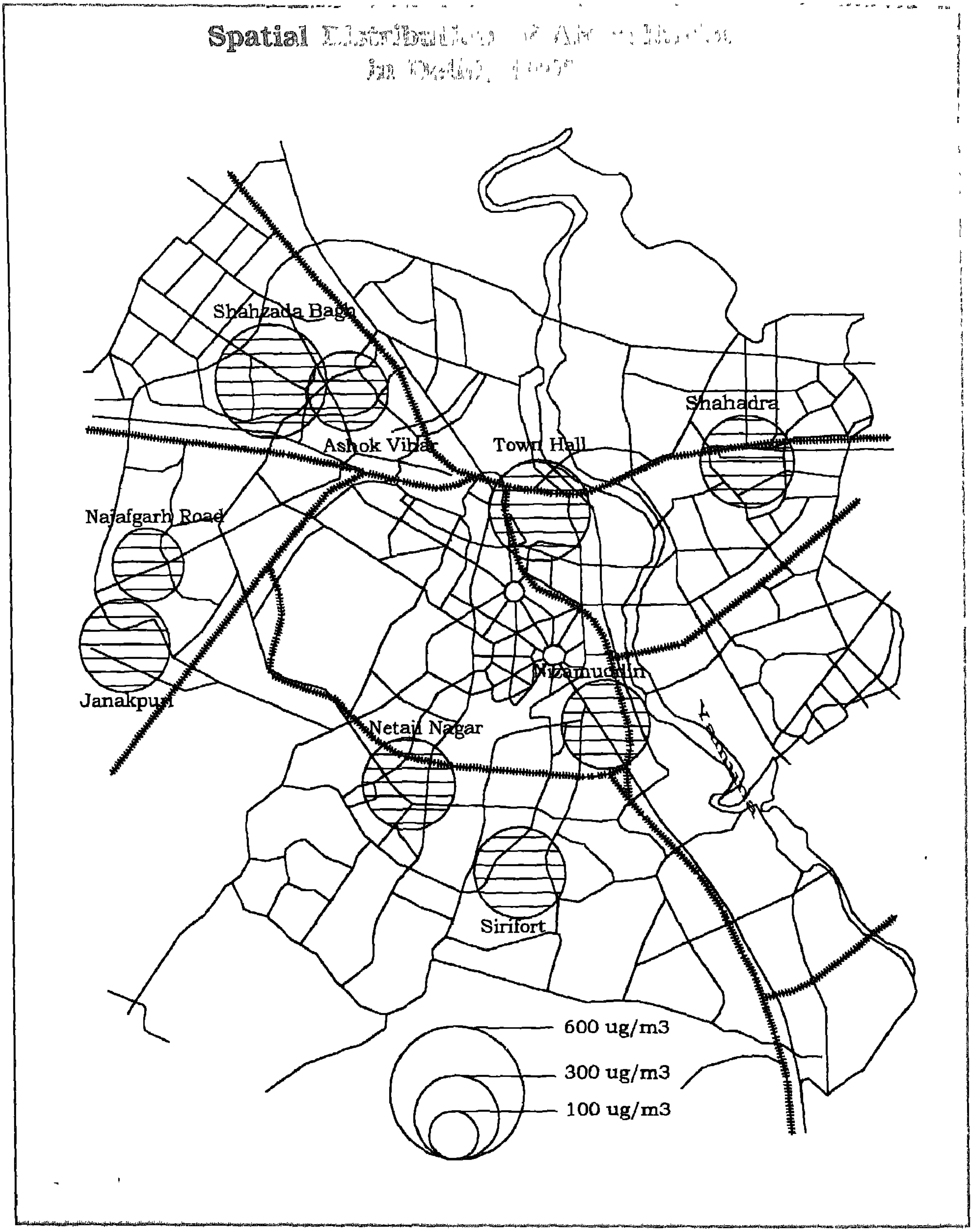


Fig. 5.4 : Spatial Distribution of Air Pollution in Delhi, 1992

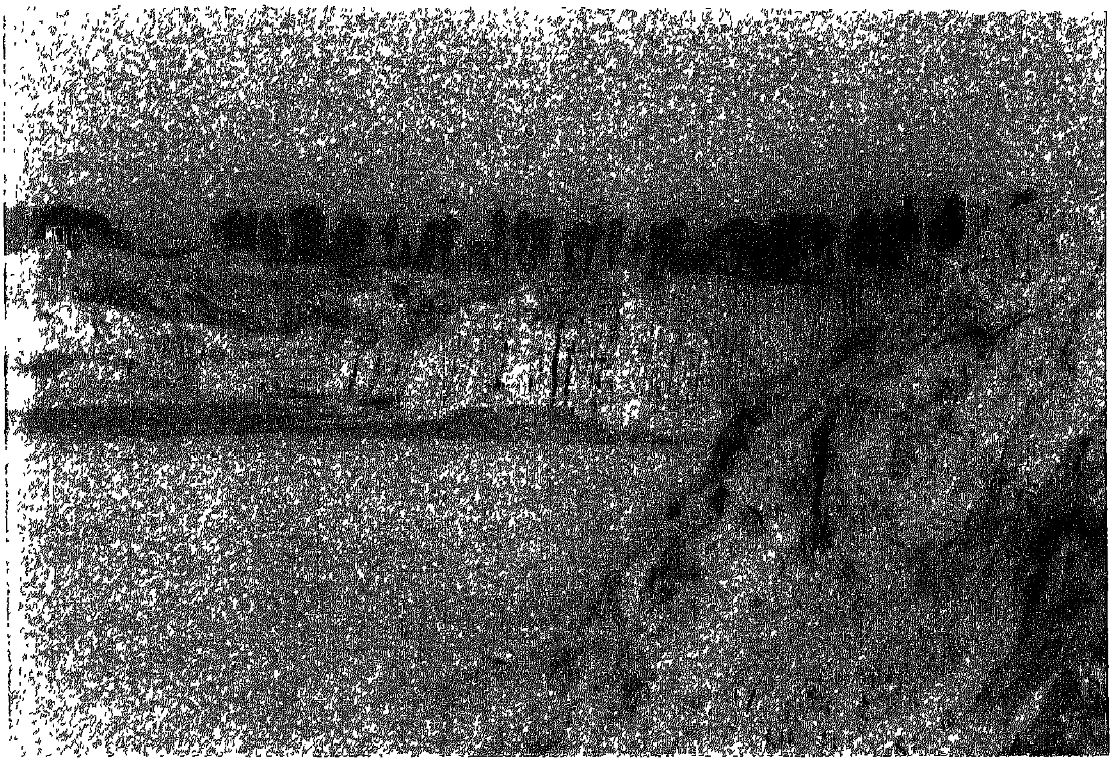


Fig. 5.5 : *Growing Degraded Land . An Eight-metre Sand Quarry Pit*

diagrammatic sections. The erosional factors prominent in the area, the nutrient quantity and quality of soil have to be taken into account. The crop from land and use pattern being followed in the area, the irrigation facilities available, the drainage, water logging, salinity and alkalinity status of the area, the vegetation of the area have to be recorded. The mapping has to be done according to degradation status. Interpretation of the results has to be done with a view to suggest various strategies to improve the situation.

Study of Droughts and Floods

Droughts and floods are frequent phenomena in India. They take a heavy toll of life and property. Mapping of flood and drought prone areas and preparing plans to mitigate their effects, have now become an important task. The mitigation plan should have three broad aspects :

1. Risk reduction to the maximum extent based on given standards,
2. Optimal risk reduction based on limitations, and
3. Saving lives and property.

The maximum damage that can be done by a disaster has to be assessed in a quantitative as well as qualitative form. Further, the optimum carrying capacity of a region has to be assessed as well as calculated and limitations should be made for the activities that may lead to the disaster.

Several other preventive measures should be devised that can effectively mitigate the disaster. The most notable among them is active public participation. Emphasis should be laid to both technical and non-technical measures. An extensive field survey in the disaster prone region would help to understand the real issue and use of numerical and statistical methods with computer aided precision maps for prediction should be used.

Study of Energy Issues

Students can undertake survey to monitor rural and urban energy consumption pattern. In many ecologically fragile areas such as mountains, hills and forested regions, fuelwood

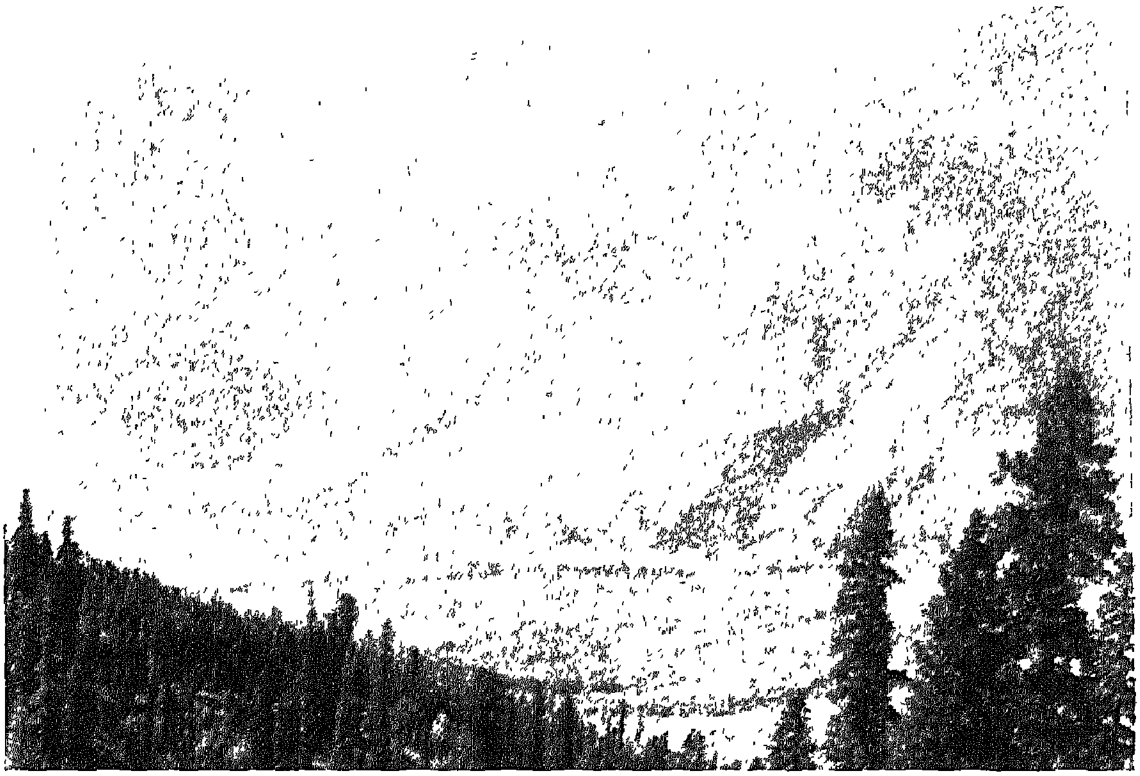


Fig. 5.6 : Human Settlement and Forest, Beas Basin, Himachal Himalaya

still continues to be relevant Various studies reveal that rural firewood consumption was unlikely to be a major cause of deforestation because it was largely in the forms of twigs and branches. But urban firewood consumption was made up of logs which are considered a source of pressure on forests. The decrease in the supply position of firewood, as highlighted by the experts after reviewing the current situation in India regarding the rural firewood consumption, is an interesting development. Regular survey can be conducted on various aspects of such emerging issues and people's performance on tree planting An important area of survey will be to conduct study in fuel-wood prices.

Similarly, one can study many other problems through field survey.

EXERCISES

Review Questions

1. Answer the questions briefly
    (a) What is the significance of the field survey in geography?
    (b) What is the steps and preparation for field survey?
    (c) What are the importance of personal observation?
    (d) What are the objectives of household survey?
2. What is Questionnaire method? Compare semantic scale questions and open ended questions.

3. Study the given data describing number of villages in nine districts of National Capital Territory of Delhi and prepare a table using Tally mark method.

District	*Number of Villages*
North-West	66
North	6
North-East	13
East	3
New Delhi	-
Central	-
West	9
South-East	52
South	16

4. Prepare a schedule for collecting energy related data by interview method.

6

CHAPTER

Spatial Information Technology and Computer Cartography in Spatial Data Processing

Cartography is undergoing dramatic changes driven primarily by technological developments in both computer and telecommunication fields.

Modern cartography can be represented by a triangle whose arms signify three basic elements which go to give it a new significance:

1. Formalisation
2. Cognition and analysis, and
3. Communication.

'Formalisation' forms the base of the triangle; it represents the cartographic production aspects. Cognition and Analysis and Communication are the other two sides (Fig. 6.1). Currently cartography is facing challenges due to fast emerging developments in computer, multimedia and telecommunication fields. Map designers have greater opportunities to utilize computer and multimedia for spatial data processing. Every year a large number of new softwares are developed. Some of the main GIS and mapping softwares are : Apple, Arc Info, Auto CAD and Map Info, GRAM and so on.

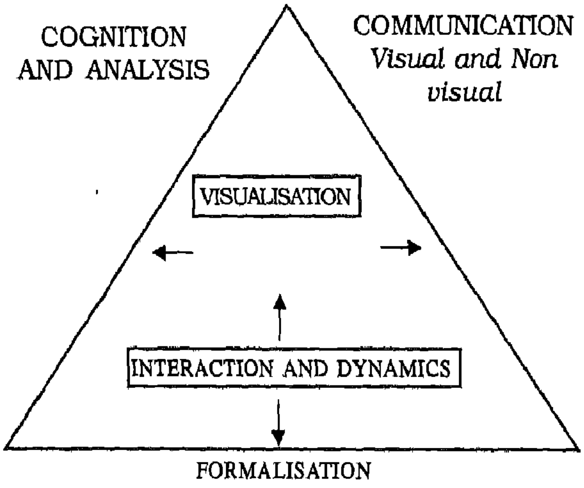


Fig. 6.1: *A Conceptual Basis for Cartography*

Use of computer in cartography helps in the following ways :

- Maps are made quickly.
- Maps are made according to user's needs.
- Map construction is possible even if skilled cartographer is unavailable.
- Map making has become less expensive.
- Maps can be made more attractive.
- Map reproduction has become fast.
- Updating of the map can be done if data are in digital form.

The space technology has changed mapping in many ways. Softcopy images have replaced printed maps for many applications. Production time has been reduced drastically. For military intelligence and micro-planning for development needs, a timely high resolution image of a designated site can be obtained in minutes by moving a nearby satellite into a new orbit. Automation is also changing the quality as well as variety of spatial information that can be mapped. Further, Geographic Information System (GIS) is expanding the role of spatial mapping and analysis in decision-making.

Why Spatial Information Technology?

Resource management of a region is performed either by manual map overlay method or by computer technology using numerical spatial data sets or geo-based files. Manual overlaying to transparent maps with a view to produce multi-temporal maps has its limitations. Only a few maps can be overlaid simultaneously for visual analysis. The computer-assisted approach requires information in digital form. In this approach inter-relation of resource features (attributes or factors) is performed through numerical transformations. The development to modern data-gathering techniques and computer assisted cartography gave new impetus to spatial data storage and exchange. Simultaneously, the combined use of Geographic Information System (GIS), and Digital Image Processing (DIP) provide better prospects of geographical monitoring and forecasting over wider areas within limited time-span. It would be easy to develop predictive modelling capabilities for effective public policies in years to come.

ELEMENTS OF DATA STRUCTURE

Both graphic variable and text help in giving a good aesthetic look to the map. Information about the map is shown through the graphic variable and text.

The following six basic types of graphic variables are popular :

i. ***Size of typography :*** Differences in size of the symbols and lines showing the spatial distribution pattern of a phenomena without much clustering. The dots of different sizes represent different quantity of an element.

ii. ***Lightness or grey value :*** In this process the distribution of an element is shown by the variation in the intensity of grey colour. The lighter shades show lower densities and deeper or darker shades show higher densities.

iii. ***Grain or texture :*** The distribution of an element is shown by different shades to represent varying intensity or density. In this method black and white colour are mostly used. Changing the ratio of black and white colours shows the variation intensity of an element.

iv. ***Colour Hue :*** Hue refers to various colours we perceive : red, green, blue, and combinations. This method makes use of different colours to make the distribution of various features distinct on the map.

v. ***Orientation :*** Differences in orientation refers to patterns and not to the line elements that form the base map.

vi. ***Shape :*** Shape can refer to the differences in the points, lines and area patterns used as symbols. The various symbols are included for identifying shape differences. Geometric shapes are used to show various attributes on map.

GLOBAL POSITIONING SYSTEM – VITAL SOURCE OF SPATIAL DATA

The Global Positioning System or GPS is all-weather radio navigation system developed by US military in which individual receivers process data beamed down from satellites. It provides three-dimensional positions 24-hour-per-day basis around the world. The space satellite system consists of 24 satellites in a circular orbit and with an orbital period of 12 hours. The orbits are inclined to equator at 55 degree. The satellites carry an atomic clock moving and generating stable signals. These signals carry information about time and ephemeris (position of satellites at a particular point of time) of satellites. The ground receivers receive these transmitted signals to compute the position on the earth based on the satellite position. Most of the navigation systems use input from just one satellite receiver. This provides latitude, longitude and altitude of any spatial unit. Thus, the GPS has been contributing greatly in the field of spatial mapping.

Geographic Information System

Many scholars defined Geographic Information System or GIS in various ways. Geographic Information System or GIS is a database of a particular kind containing spatial information about various levels of observations. GIS can be considered as a tool to analyse resource and environmental information in a spatial context. Development of a GIS database requires a clear understanding about its multi-level structure (Fig. 6.2). The following definition is worth mentioning :

GIS can be defined as :

"A powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world".

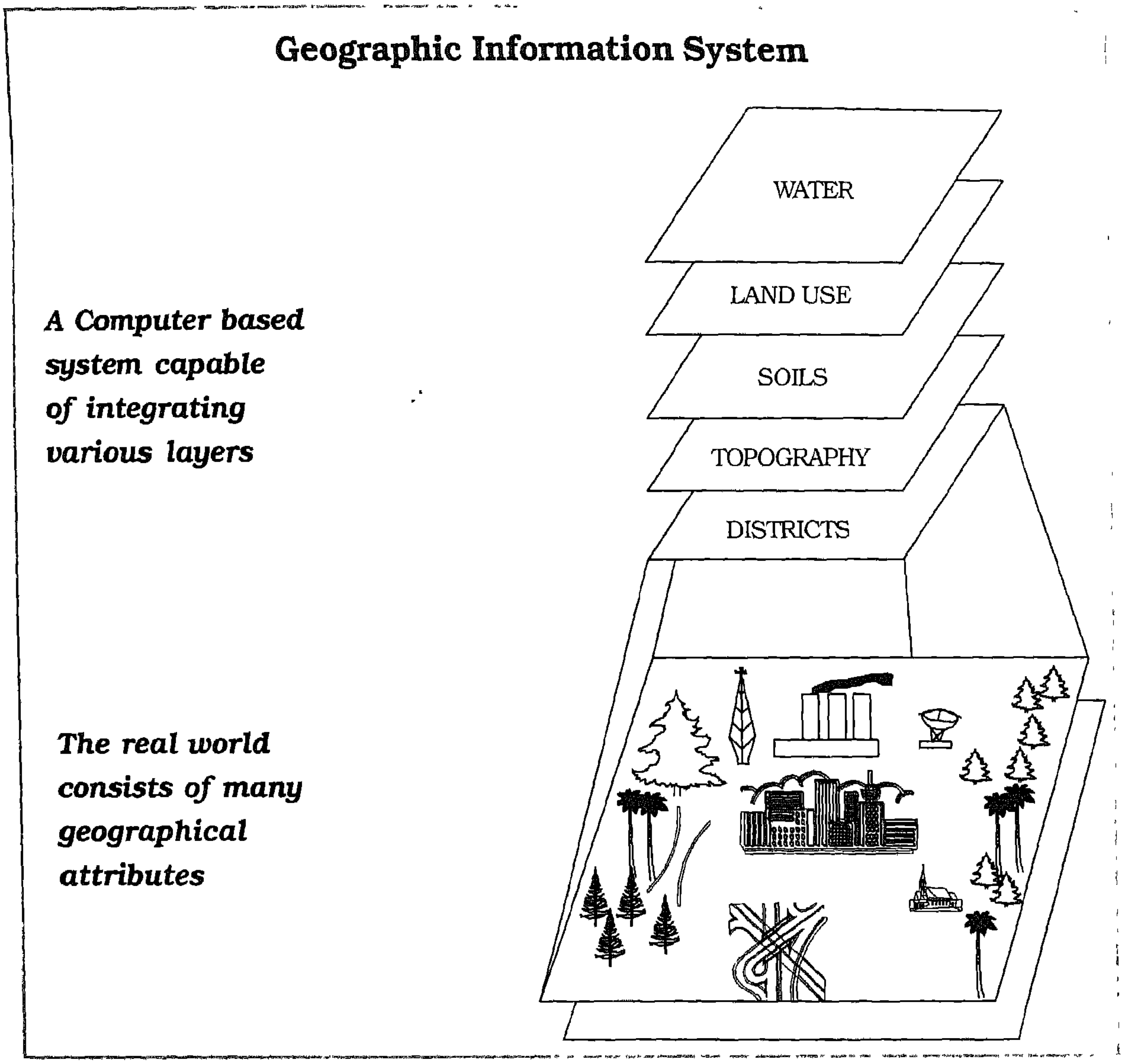

Geographic Information System
A Computer based system capable of integrating various layers
The real world consists of many geographical attributes
WATER
LAND USE
SOILS
TOPOGRAPHY
DISTRICTS

***Fig. 6.2** : Geographic Information System (GIS)*

Thus, GIS is a computer-based system for the processing and the analysis of geo referenced multivariate data. The GIS system provides easy access to stored geographical data, customised maps and selective database query. It is easily possible to show forestland, and for reference showing major roads and administrative boundaries in a database of land cover. Internationally the research on GIS started in the early sixties. However, it is a recent phenomenon in India Various kinds of GIS include Land Information System (LIS) or Environmental Information System (EIS).

Advantages of GIS

GIS provides an opportunity to interpret various geographical, topographic, socio-economic spatial data in relation to spatial analysis and modelling. The emphasis is on integration of conventional land based and remotely sensed data so as to develop comprehensive databases suitable for various levels of spatial planning. This can be used for development and planning. In this way, GIS can play an effective role for decision support system of sustainable development and management of the natural resources. The environmental resources are a prime natural capital for human sustenance and development. Thus development, utilisation and conservation of environmental resources are one of the major priority sectors in the national planning process. Therefore, one can describe the following components of GIS :

- Creation of precise and adequate structured resource inventory or data base.
- Monitoring of geographical, hydrological and socio-economic activities, etc.
- Analysis of current and time variant information.
- Testing of scientific hypothesis about the interaction and functioning of environment and to predict resource potentials, and
- Prepare development plan and resource management strategy.

Types of GIS : Vector and Raster

GIS analyses the attributes and their interactions within a region or space. There are two different types of GIS : vector or polygon; and raster or grid structure (Fig. 6 3) Vector structure denotes spatial units of their features to be represented. Such units are of uniform size and shape and show relative location within an area. In the raster (image) data, spatial objects are made of contiguous cells sharing the same attribute within the regions. Attribute dimension is described as a set of grids in which the value assigned to each cell expresses its overall characteristics. The merits and demerits of the two GIS modes are given in Table 6.1.

Functions of GIS

GIS has many practical applications. Important among them include :

1. ***Mapping (Cartography)***
2. ***Database Management***
3. ***Data queries based on***
   Spatial/ Location
   Attribute/ Features
4. ***Spatial modelling***
   Capability, suitability analysis
   Sensitivity analysis
   Simulation

GIS can answer question on .

• Location	Where is it located ? What is the flow of the river at this place?
• Condition	Where all the land within 200 meters of a river lies in an urban area?
• Trend	What has changed through time ?
(Temporal Analysis)	What has changed in the quality of water during the period of lowest water level?

Table 6.1 **: Properties of the Two GIS Modes**

Properties	Object Mode	Image Mode
Structure	Vector	Raster
Spatial Sampling	Variable	Constant
Units of Observation	Phenomenon Dependent	Phenomenon Independent
Spatial Measure (X,Y)	Precise	Unprecise
Continuous Spatial Distribution	Complex	Simple
Data Structure	Complex	Simple
Storage Compactness	High	Low
Spatial Analysis	Complex	Simple

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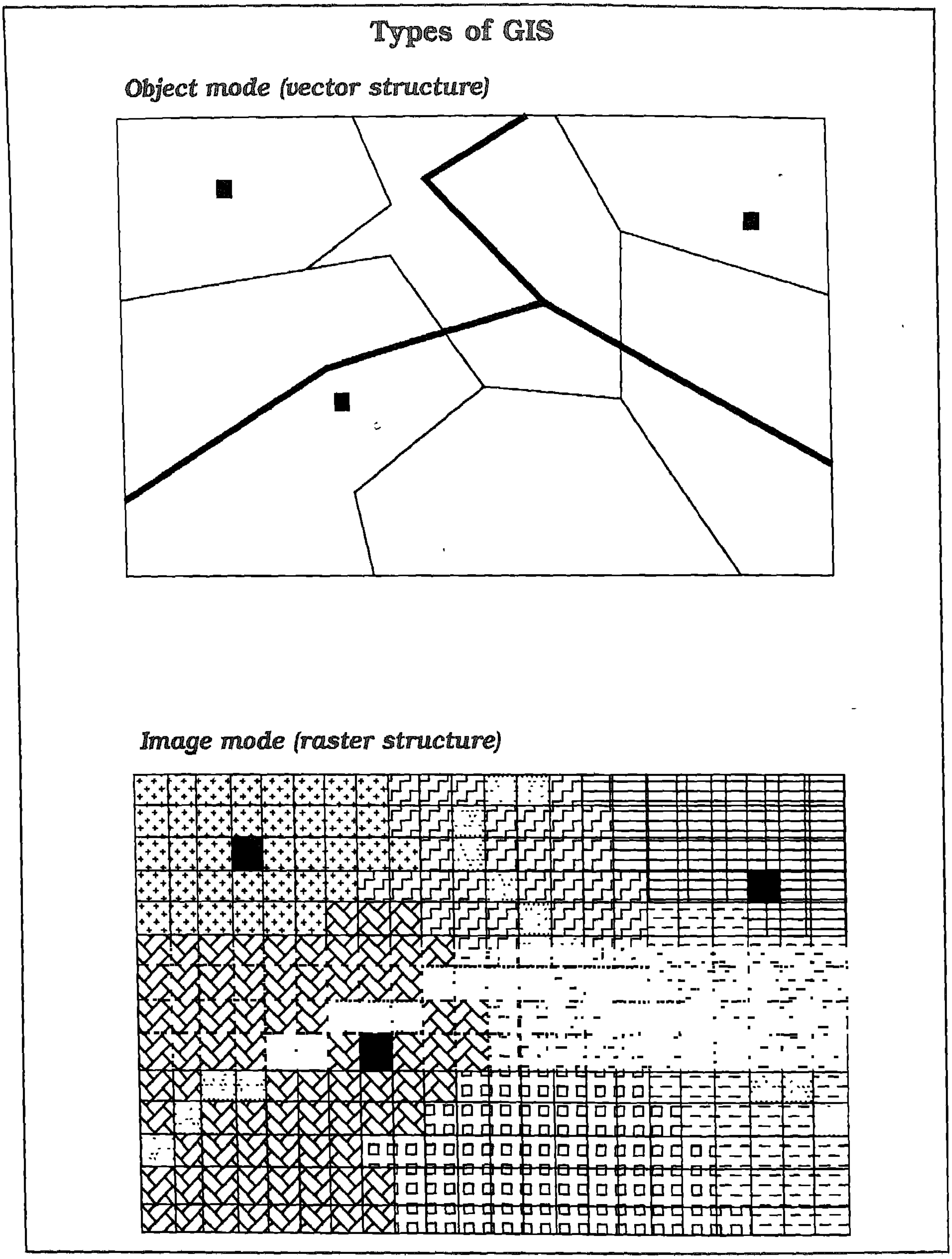

Fig. 6.3 : *Type of GIS Object Mode (Vector Structure)*

• Routing	Which is the best way to go ?
(Decision Analysis)	Which is the quickest way to reach this town?
• Pattern	What is the pattern of a given phenomena?
(Spatial analysis)	Is there any pattern in the distribution of soil?
• Modelling	What if climatic changes continue in future?
	Which areas of the earth will be affected by a rise of 20 centimetres in sea level?

Thus, GIS can be used with great advantage to resolve problems related to :

1. *Network-based services management for :*
   - address matching
   - vehicle routing and scheduling
   - location analysis, site selection
   - development of evaluation plans.
2. *Natural resources management for :*
   - forest
   - wildlife habitat and migration routes
   - recreational resources planning
   - floodplains
   - wetlands preservation
   - agricultural lands
   - groundwater modelling and contamination
   - tracking environmental impact analysis (EIA)
   - view shed analysis.
3. *Land parceling :*
   - zoning, subdivision plan review
   - land acquisition
   - environmental impact statement
   - water quality management
   - maintenance of ownership.
4. *Facilities management:*
   - locating underground pipes, cables
   - balancing loads in electrical networks
   - planning facility maintenance
   - tracking energy use.

Application of GIS

We have now become acquainted with the potential use of GIS in solving our problems such as land and forest cover change, water and air quality assessment, soil erosion risk analysis, natural hazard monitoring, selection of afforestation areas, land capability and suitability analysis, and data directory study. Worldwide experience has shown that remote sensing and GIS are very effective tools for resource management. The new age of microcomputers and increased potential for information exchange help in its use in India too.

Geographical Information System (GIS) offers such capabilities as they integrate multi-sector, multi-level and multi-period database. Subsequently, GIS can be used as decision support system identifying and integrating, monitoring and predicting natural hazards which are the major environment risks experienced in India. Integrated Watershed Management Plans consequently could help to reduce the impacts of disasters that continuously threaten us.

CASE STUDIES

Land Use Change Monitoring

Land use is an important input in the geographical monitoring of rural as well as urban resources of a region. The general land cover classification can be derived from past changes in land use in general and forest cover in particular. Deforestation, for example, is a serious ecological problem in the Himalaya. Forest maps of two time periods can provide information of forest cover changes (Fig. 6.4). Satellite remote sensing can be effectively used for land use mapping and for monitoring forest degradation process in the country. Due to rapid change, the information collected by conventional methods becomes outdated.

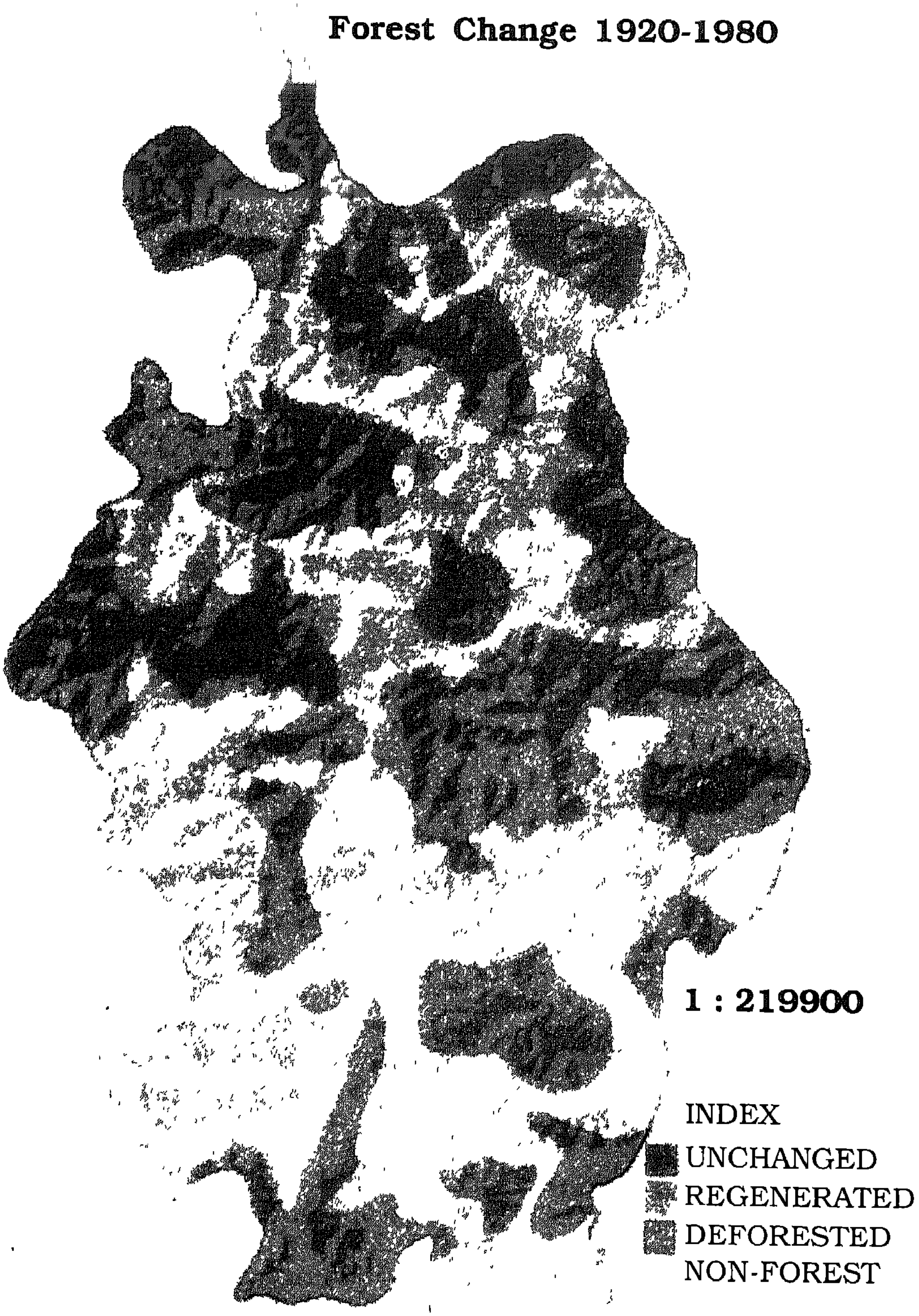

Fig. 6.4 : *Forest Change 1920-1980, Chakrata Tehsil, Dehradun*

GIS : Multi Criteria Analysis

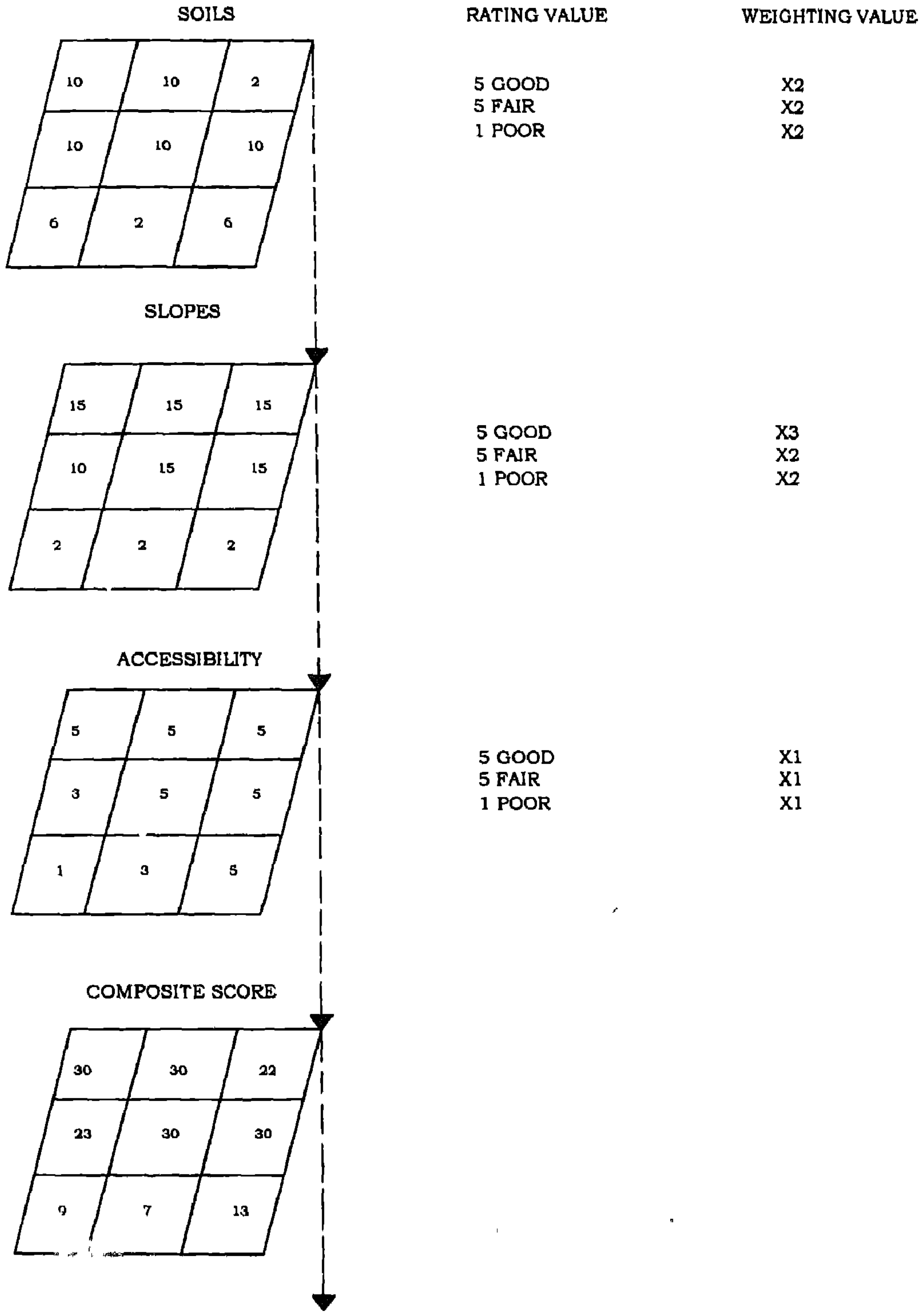

Fig. 6.5 : GIS Multi Criteria Analysis

LAND SUITABILITY ANALYSIS FOR SOCIO-ECONOMIC PLANNING

Land use suitability analysis helps in taking decision on different land related developments. The GIS analysis integrates various natural, anthropogenic and interactive factors to produce three types of maps.

1. Map showing what land use will cause the least change in environmental processes,
2. Map showing qualitative predictions of environmental impacts of proposed development. It also gives certain projects to be carried out and specific environmental actions to be controlled; and
3. Map showing the best and least suitable locations for those actions.

Land use planning in marginal regions like Himalayan region, Rajasthan desert requires such mapping. The analysis of land suitability for agriculture in highlands will produce information and maps related to soil erosion, slope, altitude, water availability and nutrient availability The U.S. Department of Agriculture, Soil Conservation Service has developed the agricultural Land Evaluation and Site Assessment (LESA) system to determine the quality of land for agricultural uses and to assess agricultural land areas for their economic viability. India should also take up such a project. Multi-criteria Analysis has become popular for integrating various GIS maps like soil, slope and accessibility by indicating their ratings and weightage in order to ascertain a final GIS product.

Many countries and state governments have attempted to computerise land and other geographical information for municipal operations. Planning departments have made attempts to automate parcel maps. Environmental planners have attempted to automate environmental overlays for land suitability/capability. Such information includes base map, environmental, engineering, plan/profile drainage, parcel/street address tabular data, area tabular data, street network file and area boundary maps, etc. The GIS software tools allow different data sets in mapped or tabular form to be corrected, interrelated and interpreted in a variety of ways.

To make the best use of the GIS, effective networking is essential. It bridges the gap between the data providers, users and end-users. It is important that sharing digitised GIS data as well as socio-economic and statistical data is a key issue to promote spatial technology for sustainable development. Therefore, spatial technology has become a key science for decision support of sustainable development and management of environmental resources.

EXERCISES

Review Questions

1. Answer the questions briefly ·
   - (a) What is GIS?
   - (b) What are the main types of GIS?
   - (c) What are the three basic elements of cartography?
   - (d) What is the importance of computer in cartography?
   - (e) What are the elements of data structure?
2. Write short notes on the following :
   - (a) Spatial Information Technology
   - (b) GPS Definition of GIS
   - (c) Application of GIS in Socio-economic planning
   - (d) Application of GIS in monitoring land use change.
3. Compare vector and raster GIS.
4. Write a short note on GIS application in land suitability analysis.

GLOSSARY

Bar Graph : A series of columns or bars drawn proportional in length to the quantities they represent. They are drawn on a selected scale. They may be drawn either horizontally or vertically.

Cartogram : The representation of statistical data on a map in a diagrammatic way. It is one of the important and popular tools of modern geography.

Central Tendency : The tendency of quantitative data to cluster around some value.

Choropleth Maps : Maps drawn on quantitative areal basis, calculated as average values per unit of area within specific administrative units, e.g. density of population and percentage of urban to total population. Distribution of a given phenomenon is shown by various shades of a colour or intensity

Class Intervals : The difference between the lower and upper limits of any class of a frequency distribution is known as its class interval.

Correlation Co-efficient : A measure of the degree and direction of relationship between two variables.

Cumulative Frequency : The measurement of distribution of values in the different class intervals expressed as a percentage of the total frequencies either above or below specified value

Dispersion or Spread : The degree of internal variations in the different values of a variable.

Flow Maps : Maps in which the "flow" or movement of people or commodities is represented by riband whose thickness is proportional to the quantity of goods or the number of people moving along different routes.

Histogram : A graphical representation of a frequency distribution, such as seasonal frequencies of rainfall.

Mean Deviation : A measure of dispersion derives from the average of deviations from some central value Such deviations are taken absolutely, i e , their signs are ignored The central value is generally mean or median.

Median : It is the value which divides the number of observations in such a way that half the value are less than this and half of them are more If the values of a variable are arranged in either ascending of descending order, the median is the middle value.

Mode : The mode is that value of a variable which occurs maximum number of times.

Quartile : Quartile are the values of the variable which divide the .number of observation in four equal parts

Relative Dispersion : The ratio of the measure of dispersion of a frequency distribution to its measure of central tendency.

Standard Deviation : The most commonly used measure of dispersion. The standard deviation is the positive square root of the mean of the squares of deviations from the mean.

Tabulation : The process of putting raw data into a systematically arranged tabular form

Variable : Any characteristic which varies. A quantitative variable is a characteristic which has different values; the differences of which are quantitatively measurable. Rainfall, for example, is a quantitative variables, because the differences in its different values at different places or at different times are quantitatively measurable. A qualitative variable on the other hand, is the characteristic; the different values of which cannot be measured quantitatively Sex, for example, is a qualitative variable, it can be either male or female. A qualitative variable is also known as an attribute.

Wheel Diagram .: A circular diagram in which a circle is divided into sectors for presenting data in percentage.

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